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America's Wonderful Submarine Automobile Boat

The Protector Floats, Dives and Rolls Along the Bottom of the Sea on Wheels as Desired--Submarine Cruiser Will be Next

Editor's Note:. The destructive work done by the Japanese submarine boats in the attack on Russia's ships at Port Arthur and the remarkable success that has recently been attained by United States Combination Submarine Boat "Protector," furnish convincing proof that the under-water boat is a practicable and powerful implement of war and mark a new era in the construction of this type of vessel. The "Protector" is more formidable than any submarine Japan may possess. Provided with wheels for traveling on the bottom of the sea and with newly designed machinery that admits partial or total submergence at will and propels the vessel rapidly and accurately on or under water, the "Protector" might be called a combination submarine automobile and submarine boat.

Until recently "submarines" have been experimental constructions. The "Protector," more than the Japanese boats, places them in the list of real fighting vessels that are to be counted among the most formidable equipments of the navy. Not only this, but it is believed that the "Protector's" success has paved the way for the advent of an entirely new type of war vessel—the "submarine cruiser"—designed to travel in deep water and attack the enemy in transit and a craft of far greater size and destructiveness than the submarine torpedo boat.

Elated over the success of the "Protector," the United States contemplates the immediate construction of other vessels of her type and with these to guard the coast it is believed America's harbors will be impregnable to any possible assault of the most powerful fleets of the combined nations of the world.

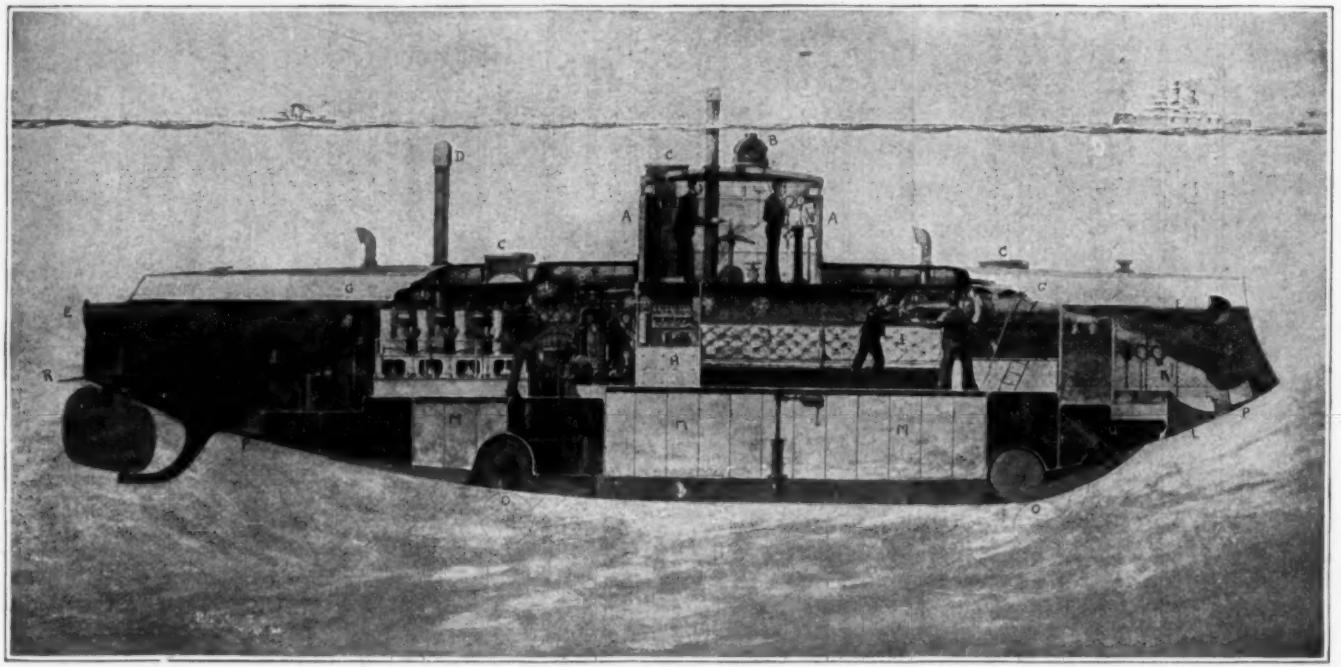
Popular Mechanics has been so fortunate as to obtain a description of the new submarine by Lieut. John Halligan, Jr., the well known naval expert, who has made many trips under the sea aboard the boat and who, probably, is better capacitated to write on the subject than any other authority.. Lieut. Halligan is a regular contributor to the Journal of the American Society of Naval Engineers, the official organ of the Society and the world's authority on American naval affairs.

By Lieutenant John Halligan, Jr., Member of the American Society of Naval Engineers

The submarine, when within torpedo range, is the superior of the battleship, since the battleship is vulnerable to the torpedo—the weapon of the submarine. In the ability of the submarine to submerge itself to considerable depth and thus secure the protection of an incompressible liquid medium, the craft possesses the power to assume an indefinite thickness of armor. This, combined with its invisibility, makes the submarine doubly secure from the gun—the weapon of the battleship.

The first qualities demanded of the submarine are naturally those of ready submergence and ability to maneuver at will while submerged. Indeed, in most types of the past, this, except for ability to place or discharge a torpedo, was the only accomplishment hoped for; speed, seaworthiness and cruising ability being considered as foreign

The Inside of a Submarine



Inboard Profile

A. A. Bronze Conning Tower
B. Sighting Hood
C. C. Hatches
D. Exhaust from Engines
E. E. Torbedo Tubes
F. F. Gasoline Tanks
G. G. Line of Spindle Hull
H. Galley Compartment
I. I. Crew Space
J. Air Lock
K. Diving Compartment
L. Diving Door
M. M. Storage Batteries
N. N. Drop Keel
O, O. Wheels
P. P. Anchor Weights
Q. Q. Ballast Tanks
R. Horizontal Rudder

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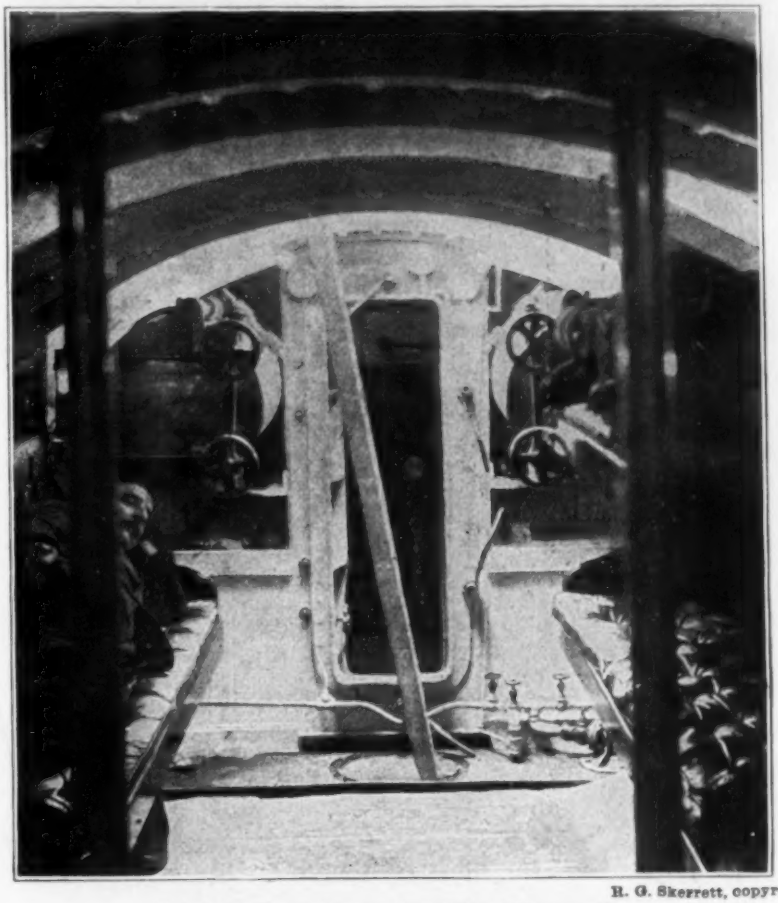
to the type. Heretofore it has been generaly accepted that the submarine, like the devil fish, must to a great extent lie in wait for its prey. It has thus been granted the security of a harbor for base of operation, and its field of usefulness has been narrowed to the defense of that particular port. Changes of base as well as cruises to distant points, heretofore, have generally been made from the end of a towline.

The combination of facility of submergence with comparatively great longitudinal stability secured in the Protector, is the most remarkable feature of this interesting boat.

Since the Protector was launched she has been in active commission under command of her designer, with a crew of seven skilled men and a steward. Since July 9, 1903, the writer has been on board during all runs and submergencies. Submerged runs have been made at depths of 48 feet in depths of water to 16 fathoms. In a rough sea there is some difficulty in handling the boat for submerging, due to fluctuations of water level in the buoyancy gauge, but once submerged there is no difficulty in handling her under the conditions thus far experienced.

The Protector has an installation of gasoline engines which can be used while the boat is partly submerged. When entirely submerged electric motors are used for propulsion. The marked simplicity of gasoline engines for such propulsive work, since such installation obviates the use of steam boilers and condensers, leads to the possible conclusion that the day may not be far distant when we may possess submarine cruisers, with an endurance of machinery afloat that is not possessed by the present high-speed surface torpedo boats.

While cruising the crews have always



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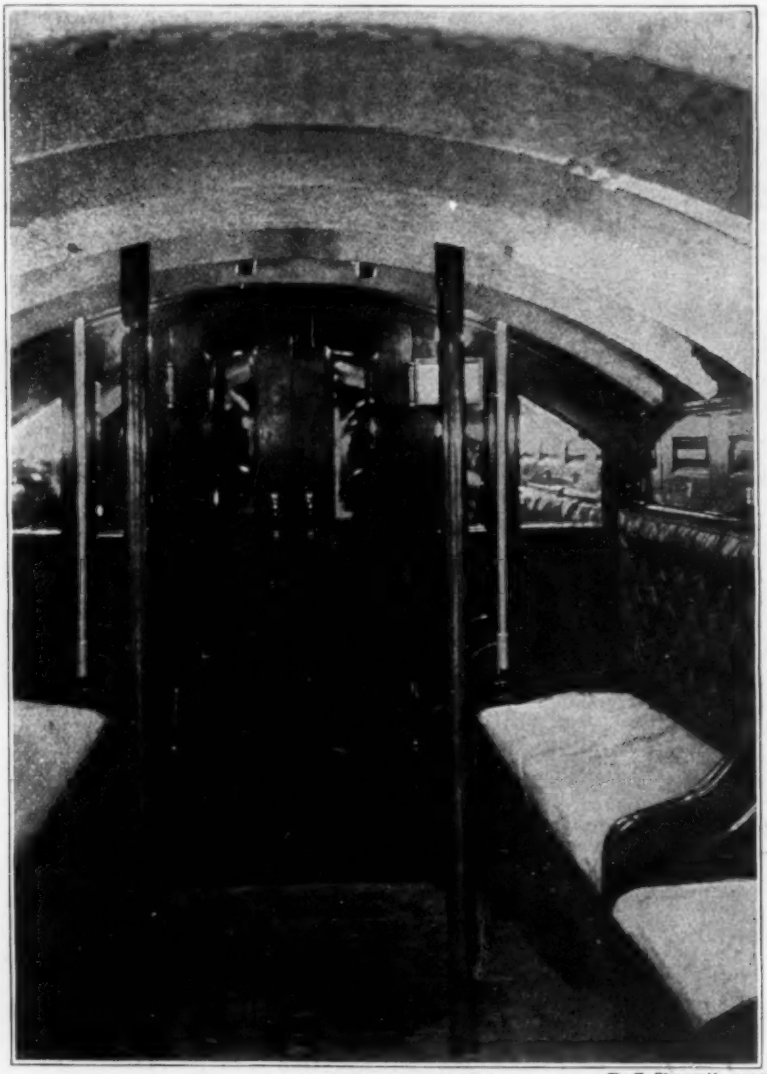
Living Quarters--Looking Forward

eaten and slept on board, the meals being cooked without difficulty on electric stoves. In all respects, save that of deck room, and under all conditions of weather, this boat provides greater comfort for the crew than



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Living Quarters--Looking Aft

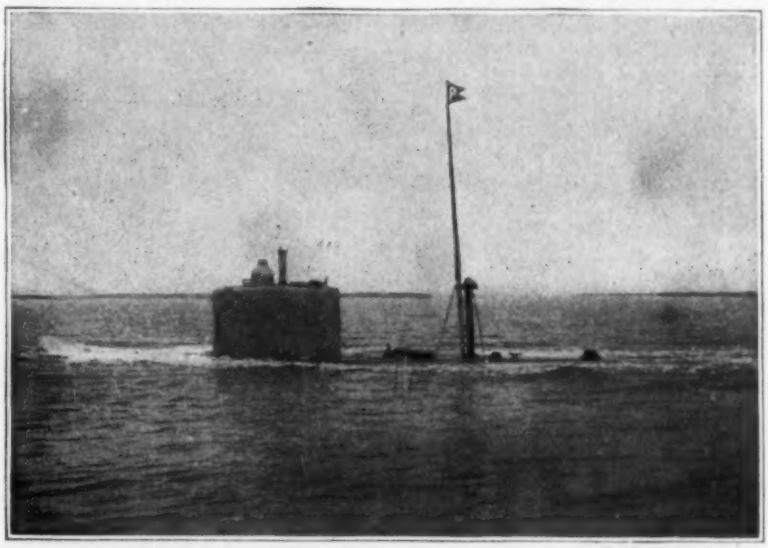
the surface torpedo boats on which the writer has served.

The Protector consists of a heavy spindle hull of mild steel, 65 feet long and with a maximum diameter of 11 feet 2 inches, with conning towers, designed to withstand an external pressure corresponding to a depth of 150 feet, and carrying a light superstructure. The superstructure is carried up from the greatest diameter of the spindle hull in a vertical direction. Midway in the length is a watertight transverse bulkhead, which divides the superstructure into two ballast tanks fitted with suitable admission and discharge valves. Access to within the superstructure is afforded through fourteen eliptical manholes, 16 by 12 inches.

In the superstructure are carried eight galvanized steel gasoline tanks with a combined capacity of 1,050 gallons; two lubricating oil tanks, holding 120 gallons; six

high-pressure air tanks with a combined capacity of 21 cubic feet and four low-pressure air tanks with a combined capacity of 12½ cubic feet.

Ventilating trunks, consisting of cylindrical bronze castings, 6 inches in diameter, worked watertight through spindle, hull and superstructure deck, carry miter valves operated by hand wheels from within the spindle hull. Watertight bronze caps cover the valves when cowls are unshipped. The spindle hull is lighted through deadlights, in trunks, worked through superstructure and provided with clapper valves serving as battle ports. At a depth of 40 feet it has been found that the hull is reasonably well lighted, it being possible at this depth to read a newspaper under the deadlights without the aid of artificial light.



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Degree of Submergence--Structure Awash

The Protector is intended to carry 3.55 M. Mark III Whitehead torpedoes, three in the tubes and, if desirable, two spare ones under the berths in the crew space. The boat's stability when submerged, both longitudinal and transverse, is such that the torpedoes may be loaded without materially affecting the trim of the boat or the control of depth of submergence.

The forward diving compartment is, perhaps, the most spectacular feature of the boat. It is separated from the crew space by the air tight bulkhead and by an air lock 42 inches long built into this bulkhead, and fitted with air and watertight doors—the whole being designed to stand a pressure of 75 pounds to the square inch. The diving compartment is fitted with a connection to the low pressure air system, a telephone and a gauge with two hands, one of which registers the pressure due to the depth of water and the other the air pressure within the compartment. In the bottom of the compartment, forming a portion of the hull, is a cast iron door, stiffened with transverse ribs, which, when the door is opened, serve as steps. To open the diving door when resting or running along the bottom, the air lock doors are closed, a valve on the air connection is opened, and the pressure in the compartment allowed to increase gradually until the two hands on the gauge balance. A try cock in the door is then opened and the balance of the pressure verified. The door is then undogged and allowed to swing open, giving, in clear water, a good view of the bottom. A diving suit fitted with telephone connection is provided, the air hose being connected with a low-pressure air-tank in the compartment, the pressure being controlled by the diver through a valve in his helmet. Thus persons in the diving compartment are in telephonic communication with the diver and the rest of the boat.

The diving compartment provides for: Cable cutting; destruction of mines; means of escape for the crew in case of total disablement of the boat, and means of communication with shore by cable when on

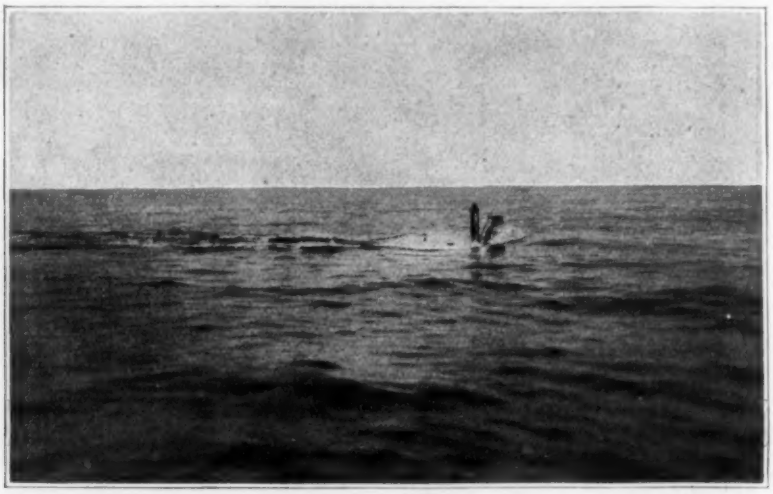
picket duty. In demonstration of these features the diving door has been opened five times in the writer's presence in depths up to 32 feet. A member of the crew in a diving suit and one in a bathing suit have been sent out, the latter to demonstrate the method of escape.

Two hollow cast iron wheels, 34 inches in diameter and with 10-inch rims are hung by forged steel jaws, pivoted through the cheeks of the keel and connected with hydraulic operating cylinders. The wheels house in pockets in the hull. The pressure in the hydraulic cylinders by which the wheels are raised and lowered, is obtained from a hand pump forward in the crew space. This installation is designed to permit the utilization of the bottom as a guiding medium. The conformation of the Atlantic coast is in many localities such as to permit a submarine to run along the bottom well beyond blockading range without reaching her limit of depth, which in the case of Protector is 150 feet. In a boat running thus, control of depth of submergence is unnecessary and, being free from the influence of currents, a much straighter course can be steered than when running between the surface and bottom.

The cushioning of the hydraulic cylinders enables the boat to take the ground without injuring the hull. In submerged runs the Protector has frequently been allowed to take the bottom. This has always been accomplished without a jar or shock. It also permits the boat to rest on the ground in a ground swell as in the weathering of a storm. The wheels are in the nature of rollers, propulsion being as in other stages of submergence. While running in this condition if an observation is desired, the boat is brought to the surface by the hydroplanes.

The conning tower carries a sighting hood, omniscope, hatch and suitable lenses affording an all around view of the horizon. Within is most of the controlling mechanism of the boat.

The boat is equipped with two four-cylinder gas engines, each of 120-horse power. The cylinders are of 10-inch diameter, with a stroke of twelve inches, and, with the bases, are water-jacketed.



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Degree of Submergence--Omniscope and Conning-Tower Hood

Ignition of the combustible is effected by a primary dry-cell battery, a magneto and a current from the storage batteries, with which combination no trouble due to lack of current has been experienced.

There is a six-pole shunt-wound Diehl motor in each main shaft line, the armature shaft of which is connected to the engine-crank shaft and to tail shaft by clutches. Each machine has a capacity of 37½ kilowatts at 125 volts when driven at 300 revolutions per minutes—a range of from 80 to 160 volts and a current capacity of 300 amperes at full load, with a momentary capacity of 450 amperes. Anchor hoist motors are located in the after end of the crew space on each side.

The storage battery compartment is mainly under the crew space. There are 60 Gould cells with spun plates of the Plante type. The battery can be discharged at a rate well beyond the capacity of the motors without injury to the plates.

The propellers are four-bladed, 45½ inches in diameter, with iron blades cast with a 3-foot pitch. The developed area of each propeller is 6.8 square feet.

The air compressor is located abaft the port engine and is designed to compress 60 cubic feet of free air per minute.

The pumps can be driven either by motors or engines and are noteworthy for their compactness.

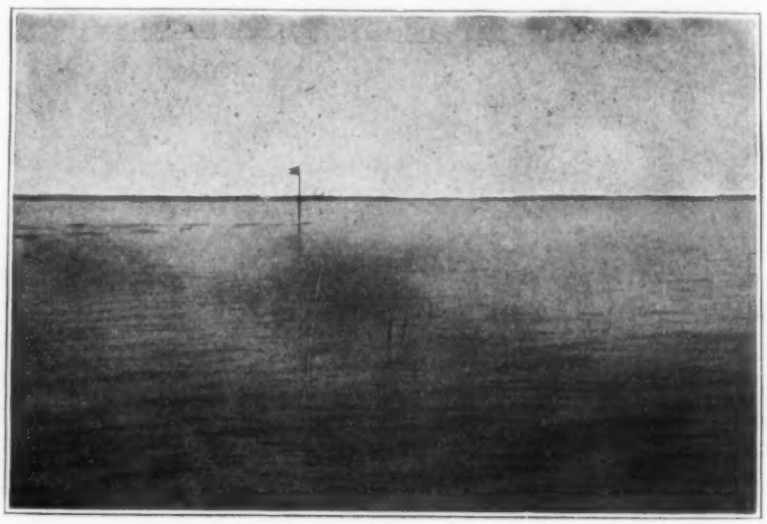
The crew space is finished in mahogany and contains eight berths and pantasote cushions. The lower berths are in the nature of transoms, for which the upper ones, when lowered, form backs. Above and behind the berths are lockers. A folding table is provided, the lower berths serving as seats. There are two electric heaters in this compartment. Adjoining the crew space is the gallery compartment with electric stoves and washroom. A toilet room is located in the after engine room. An incandescent lighting system extends throughout the boat, there being 26 sockets.

In light condition the Protector, using engines and motors, has made a speed of 9.47 knots per hour; completely submerged, using motors alone, her speed is between 6 and 7 knots; partly submerged with engines and motors, 8 knots.

The most remarkable feature of the performance of the Protector is the facility with which her depth of submergence is controlled. Transition from one to another of the submerged conditions is almost at will being well within the time required for an intelligent observation through the omniscope. This is of primary importance, inasmuch as when within sight of an enemy it is intended to run completely submerged, except for occasional verifications of bearings and range through the omniscope.

When completely submerged and when submerged so that nothing but the top of the omniscope is showing, propulsion is by the motors alone. It is intended in the near future to make improvements so that air for induction may be taken through the top of the omniscope, so that the engines may be used almost to the exclusion of the motors. The elements most liable to disability in the submarine of today are the storage battery and the electrical equipment. Could the electrical equipment of the submarine be removed in its entirety the ability of the type to keep the sea without necessity of repairs would be increased three or four-fold, for it is only in this feature that the submarine is inherently short lived.

The efficiency and safety of the Protector under submerged conditions may be evidenced by the fact that no great degree of



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Degree of Submergence--Signal Mast Alone Visible

skill is required in maintaining a uniform depth, since the writer on his first submergence was allowed to operate the hydroplanes for five minutes and succeeded in maintaining a depth of between 25 and 27 feet. The control of depth, while more delicate in the higher submerged speeds, may be maintained at almost any speed.

The omniscope consists of a 6-inch rolled brass tube, led up from a convenient level in the conning tower to a height when housed of eight inches above the top of the sighting hood. It carries five upper prisms with lenses. Four of these, used as finders, look ahead, astern and on each beam, each covering a field of 21 degrees, through a reduction in size of image. The fifth lense looks ahead and covers a field of 3 degrees 40 minutes, and presents the image in its true size without distortion. The commanding officer of a submarine must, in the absence of other means of range finding, be able to observe his target in its true size.

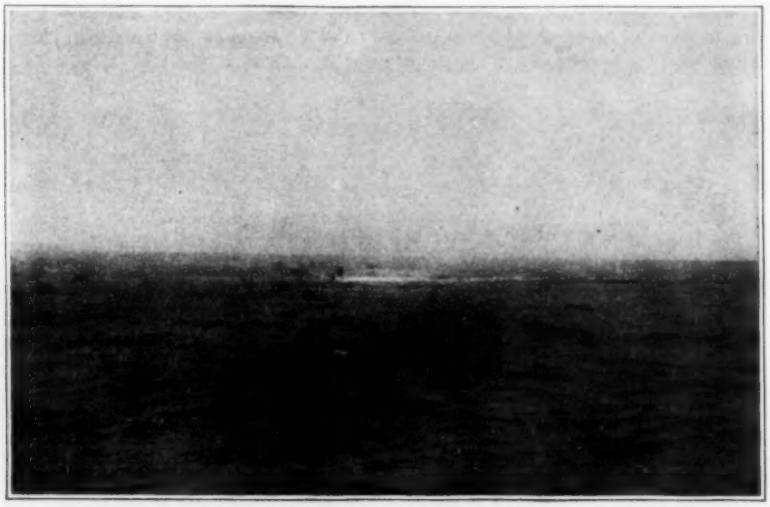
The omniscope is capable of rotating in azimuth to cover the entire horizon and can be raised two feet. It works through a stuffing box packed with leather, and is given a 12-inch bearing to take the thrust while submerged. On the lens of the direct-vision prism are two horizontal hair lines in the nature of a range finder. They are spaced to represent the height of a man at 300 yards, it being thought that in making an attack a man will generally be visible on the deck of the enemy.

The Protector has demonstrated the possibility of submerging with facility and at will without dangerous destruction of longitudinal stability, and the ability of a submarine to combine seaworthiness and habitability to such a degree as to enable her to keep the sea for long periods unattended. A study of the boat suggests:

1. That the logical development of the type will be a submersible cruiser of greater size and cruising radius with a surface speed sufficient to enable her to run down her prey and to cruise with a battle squadron.

2. That if the development of the storage battery is not such as to greatly decrease the weight per unit of horsepower and its liability to derangements, the electrical installation of the future in submarine vessels will be proportionately much less extensive than at present.

In this description, possibilities of the boat have been underestimated rather than overestimated.



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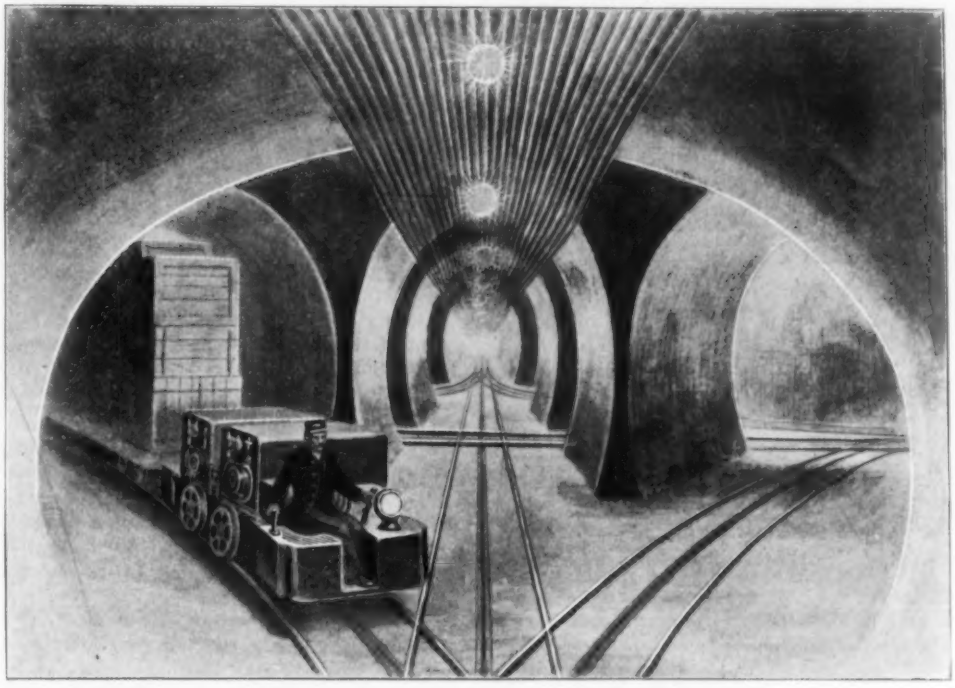
Degree of Submergence--Omniscope Awash

Did you ever notice the kind of people who write for Popular Mechanics? They are always people who know what they are talking about. Marconi writes about wireless telegraphy. Thomas A. Edison writes about electrical inventions and discoveries. M. Curie, the discoverer of radium, writes about radium. Sir Thomas Lipton writes about yachting. Santos Dumont tells about flying machines. Army experts describe submarines and shipbuilding devices. United States Consul-General Mason tells of Germany's mechanical progress. The list might be lengthened almost indefinitely. Those who know most about it are the ones we get to tell about it. This is true of all Popular Mechanics articles whether or not the author's name is mentioned.

Great Freight Railway Underneath Chicago

Most Remarkable Installation in the World to Relieve the Congestion of Streets and Terminals

Forty feet underneath the city of Chicago is being built a freight railway system, which, primarily, will handle 50,000 tons of freight daily and ultimately 300,000 tons daily. The system at first will be 20 miles in length and will honeycomb the principal business streets, connecting all the depots, five stories high. Forty feet underground the freight cars will travel; immediately above these, underground cars will carry passengers to and fro; the surface cars will perform their usual duties on the street level; the river above the tunnels and below the car bridges will have its accustomed

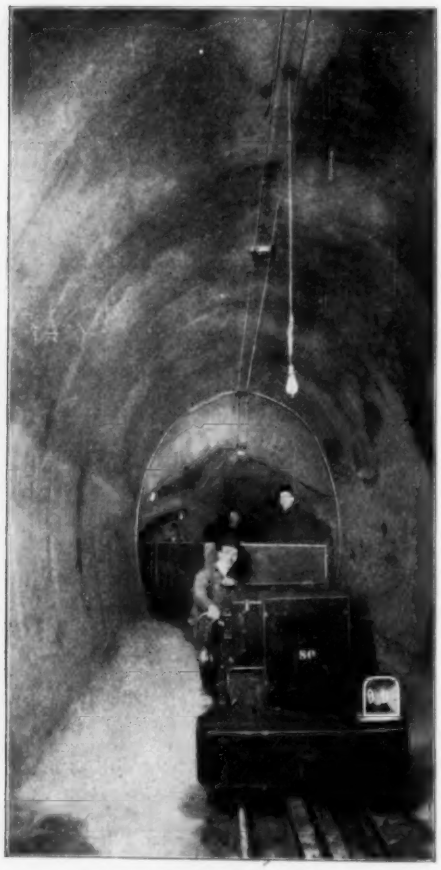


Electric Engine Hauling Freight Train Underneath Chicago

freight houses, hotels, office buildings and business houses. The freight cars will run into the basements of the big buidings, each basement being a miniature freight depot provided with switches and other facilities for loading and unloading freight.

The freight railroad is being laid in the great system of tunnels underneath Chicago's streets which was described and illustrated in a previous issue. It is now proposed that another tunnel be dug above this tunnel for the construction of underground passenger railways to relieve the streets of the congestion of passenger traffic. Thus if this latter scheme is carried out Chicago will have avenues of traffic from three to amount of boat traffic and above the river the cars will speed along the elevated roads. Probably the next step will be to build a two-story elevated road with cars running above those on the present elevated system and six stories above the freight line, which is two stories underground.

The Chicago underground freight railway will be unlike anything ever before attempted by any city. Its object is to expedite the delivery of freight, to aid the cramped railway terminal facilities and to relieve the congestion of teaming on the streets which is rapidly growing intolerable. Seven million dollars have already been spent in constructing the tunnel. It has



Underneath Madison St.

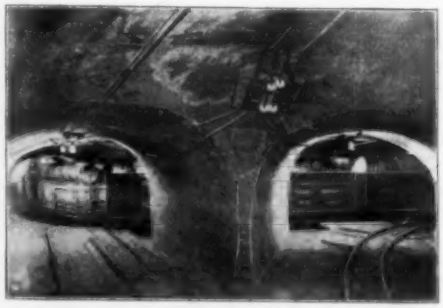
been an easy matter to obtain all the cash required for the construction work and for the successful floatation by the Illinois Tunnel Company of a $60,000,000 corporation, half in stock and half in bonds.

The work of building the railroad is progressing rapidly. Already three miles have been constructed, and two electric locomotives and 24 steel cars are in operation. The Illinois Tunnel Company, the owner of the project, has let the contract for 3,000 steel cars and 100 electric locomotives, to be in operation June 1st. The freight cars will be employed in hauling every kind of freight, including coal and all kinds of merchandise. The electric locomotives will have a capacity of 250 tons each on the level and of 100 tons on the inclines which are to be used in connecting the railroad yards and buildings with the tunnel. The cars will each hold 25 barrels of sugar, flour or general merchandise or seven tons of coal.

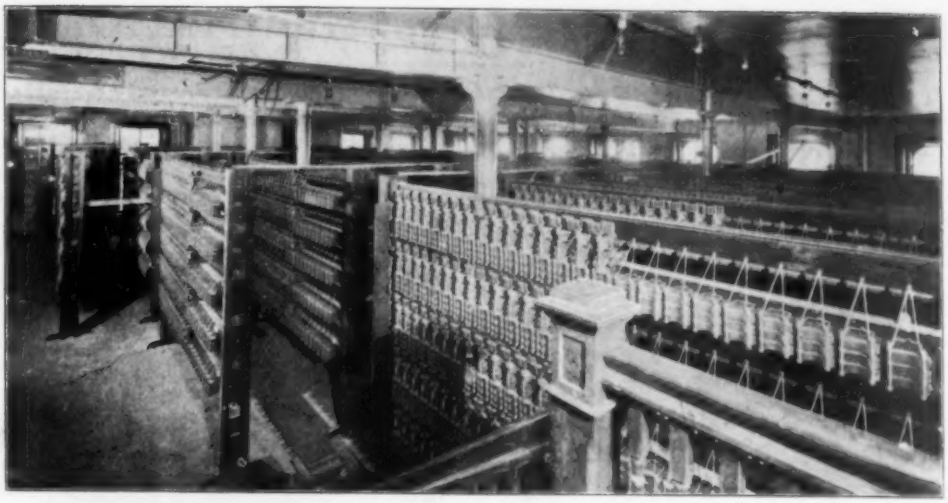
One of the most valued services of the underground freight railway will be in relieving the cramped condition of the Chicago railway terminals. It seems that the railroads exercised very little foresight in their construction when they built them. Forty per cent of the total railway mileage of the United States has terminals in downtown Chicago. Thirty-eight great railroads and railroad systems have their terminals there and these 38 are compelled to receive and deliver their freight from a mere half dozen freight depots.

At present more than $50,000,000 is spent yearly for trucking freight across the city from freight terminals to warehouses and stores. The cost to merchants averages about 90 cents per ton. With present facilities it is about the limit of capacity for a team to haul two truck loads of freight on a business day from any one of these depots. Under the tunnel system many times as much freight can be delivered and at a smaller cost for truckage. The underground freight system means certainty of delivery regardless of weather, the elimination of the coal heaver, and the doing away with the extra handling of dirt and other disadvantages connected with the present system.

Once in full operation the tunnel freight system means the removal from the streets of a vast amount of the teaming and trucking now done. It is estimated, however, that the increase in business in the next ten years will cause the tunnels to be doing as much as the teams now do and the teams to be hauling not a ton less traffic than at present. In the same tunnels where the freight cars will run telephone wires are be-



Showing Net Work of Tracks in Sub Service Freight Railway



Largest Switchboard in the World Built for the New Chicago Telephone Service, the Wires of Which are Strung in the Freight Railway Tunnels

ing strung for the new automatic telephone installation, an electric parcel delivery will be in operation and tubes will be extended for the tube system of mail delivery between the main post office, substations and depots.

On the night of February 10 the enterprise was inaugurated with an underground banquet to the Chicago Press Club and its friends, 1,200 in number. A continuous table over 1,000 feet long was set in one of the tunnels.

Tropical Hat Makers Getting Busy

Cuba and Porto Rica Anticipate Another Season of Panamas

Anticipating a continuance of the popularity enjoyed by the Panama hat in the United States of recent years, the approach of spring finds the hat makers of the tropics busy weaving the straws into shapely tiles. The accompanying illustration is from a photograph sent to Popular Mechanics from San Juan and shows a typical Porto Rican hat factory. It is very much like the picture of a Cuban hat factory illustrated in a previous issue.

The Cuban and Porto Rican Panama hats, of course, are not genuine Panamas, but are slightly inferior in quality to those made in Central and South America, which are woven under water. They are handsome in appearance and will last nearly as long as the more costly Panamas. Nearly every rural resident of Cuba and Porto Rica is a hat maker and half the homes are miniature hat factories. The making of the hats is a favorite occupation of women and children.

An Era of New and Powerful Fire Arms

Types Completely Revolutionized by New Inventions--How An Inventor's Persistence Won Him Fortune

A new age of firearms is upon us. Late inventions have completely revolutionized the style and efficiency of revolvers and shotguns. The double-barreled hammerless breech-loading shotgun, until recently considered a model of proficiency will in a short time appear as antiquated as the old time muzzle-loader, and if improvements continue as rapidly as at present, before long, it will be regarded as a curious relic even as the ancient blunderbuss is now regarded.

New Five-Shooter Shotgun--The Delight of the Duck Hunter--Sectional View

Following close after the invention of the automatic magazine "gun," described and illustrated in the January issue of Popular Mechanics, comes the automatic shotgun, destined to become the delight of the duck hunter and in all respects the most wonderful sporting arm of the age. Differing so radically in appearance and mechanism from the usual type of shotgun and possessing such phenomenal efficiency it foretells that its present odd appearance will soon become familiar to all hunters and the now common breech-loader will early become the gun to be regarded as an oddity.

Simultaneously with this shotgun has appeared a new automatic pistol, decidedly unlike the magazine gun previously described, but equally powerful. Its design and mechanism are as different from the present type of revolver as are those of the magazine shotgun from the ordinary breech-loader. Each of them looks so different from the familiar types that at first glance the unInured would scarcely recognize it as a firearm.

A very remarkable invention is this new automatic pistol. Because of its great superiority over all others, it has been adopted by the board of ordnance and fortifications of the United States army. This pistol will kill a man a mile away. It has a muzzle velocity of 1,150 feet and a range of 2,000 yards. It shoots eight shots in quicker succession than any other known hand arm, and in accuracy of aim and terrific force it is equal to most modern rifles. Its magazine contains eight cartridges and is held in the stock of the pistol. When empty the magazine can be thrown out and replaced in a moment—quicker than a single cartridge could be placed in a revolver. The pistol is of foreign manufacture and is known as the "Luger," but it shoots cartridges manufactured in this country.

The weapon shown in the illustration is

Action Open.

Pistol that Will Kill at a Mile

7.65 M. M. caliber, center fire, blued finish, walnut scored stock. The barrel is 4½ inches long and the entire length is 9 inches. It weighs 29 ounces. Its perfect balance and simplicity of action are among

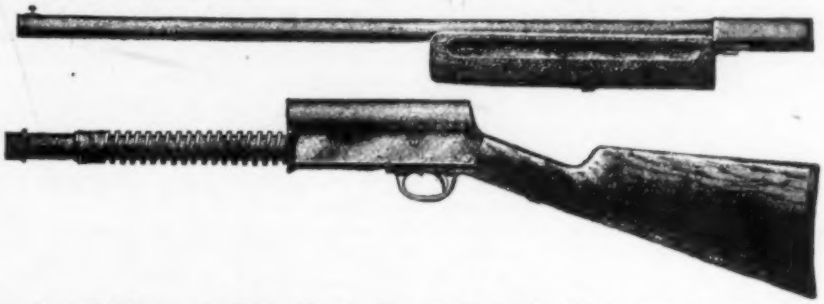
its most commendable features. The pistol operates on the link system. The recoil caused by the discharge of the cartridge forces the barrel and breech stock backward, extracting and ejecting the empty shell. The magazine spring then brings a new cartridge up into place to be forced into the breech automatically by the return of the breech block and the pistol is again loaded and ready to be discharged. The cartridges are made in either soft point or steel jacket bullets. In the recent government tests at Springfield armory, 116 shots were fired with this pistol in one minute and a score of 24 bull's-eyes out of 30 shots was made by one man firing rapidly.

THE NEW AUTOMATIC SHOTGUN.

Shooting five shots consecutively as rapidly as the trigger can be pulled, doing away with the recoil that causes the ordinary shotgun to "kick," and being powerful in its force and remarkably accurate in its aim, the automatic shotgun possesses such great advantages over the old types as to scarcely admit of comparison. In effect it is a single-trigger five-barrel gun, with but one barrel to aim, carry and clean. Two shots can be fired from it far more rapidly than from a double trigger double-barrel gun, or as rapidly as from a single trigger double gun and with much greater precision; and then three shots are left empty shell, inserting a cartridge, cocking the hammer and closing and locking the breech are performed by the recoil, leaving the arm ready to be fired again by a pressure on the trigger. In consequence of its being utilized to operate the mechanism, the recoil, which in other guns is worse than wasted on the shoulder, is largely absorbed and the shooter is spared the discomforts that otherwise result from the "kick." Also this reduced recoil does not throw the

Action Closed.

shooter out of position and consequently he can place the following shot with greater rapidity and accuracy. A woman can use this gun not only with comfort but with pleasure and it will be found a delight to all those affected with shooter's headache. The popularity for this gun has been so phenomenal that the manufacturers have been unable to supply the demand and the supply is at present exhausted.



Showing Stock and Barrel of the Automatic Shotgun Disconnected

which can be fired with equal rapidity and accuracy. The only limit of speed is the rapidity with which the shooter can pull the trigger. After the five shots are exhausted the magazine can be loaded with five more nearly as quick as a double-barrel breech-loading gun can be loaded.

The automatic gun is hammerless, with automatic ejector, single trigger, repeater, and greatly reduced recoil. It is entirely automatic in its action, excepting only that the trigger has to be pulled for each shot. All the actions—opening the breech, ejecting the

There is an interesting story of genius unrecognized in connection with the invention of the automatic shotgun. Its inventor, a youth living in Ogden, Utah, spent many years in thinking out the plans and operations of the parts. He virtually had it perfected years ago, before the automatic pistol was thought of. Believing he had a wonderful contrivance he had it patented and then set himself to work trying to get it manufactured. Being without means himself his only hope was to interest some financier or manufacturer. He laid the

plans before wealthy men of his own town, all of whom dismissed his plea with few words, saying that the weapon was impracticable. Still confident of the worthiness of his invention he left his home town and visited Chicago, where the model of the gun was exhibited to wealthy manufacturers and earnest endeavors made to interest them. In nearly all instances he was turned away without even being given an audience. Then to New York he went, with no better success, always being dismissed as a visionary inventor. The youth returned to his home in Utah, his small savings wasted in paying railroad fare, greatly disheartened but not discouraged. Like Christopher Columbus, when his own people would not listen to him, he sought foreign fields. He began to write letters to European manufacturers. In the town of Liege, Belgium, he found a manufacturer who readily recognized the merits of the shotgun and at once undertook its manufacture, agreeing to pay the inventor a liberal royalty. This manufacturer hurriedly placed the guns on the market in the United States, as well as in the countries of Europe. Its success was instantaneous. The sales in the United States far surpassed those of any other nation and the manufacturer is so elated that he has decided to build a plant in this country exclusively for the gun's manufacture. At present none of the guns can be bought. They have been sold as fast as they reached America, and the manufacturers cannot keep pace with the orders. The Chicago agency from one of the guns placed on exhibition now has 300 orders and not a single gun in stock. The inventor is in a fair way to become a millionaire.

Lipton Scores American Yachting Rules

Make Competitors' Success Impossible--Advocates King Edward's Cup Race

By Sir Thomas Lipton

So far as the American cup is concerned I do not see how any fresh challenge can be forthcoming under the present conditions of measurement. I do not mean for a moment to suggest that I have a monopoly of challenging or that I am the only man likely to do so.

But the present rule is proved obsolete. It is 50 years old and under modern conditions it makes the success of a challenger almost impossible. It is time that such go-ahead people as the Americans abandoned this out-of-date rule and framed a rational one suited to the present conditions of racing.

The recent races have shown that it is beyond the wit of even the cleverest designers to build a yacht capable of crossing the Atlantic without injury and then compete with a home-made boat in whose construction the ocean-going strain does not have to be taken into account and provided for. Why, if the last defender of the America cup had had to cross the ocean she would have gone to pieces. She could not do it. It must not be imagined that I am grumbling in the least at my luck. I never grumble. But I merely wish to impress so strongly as I possibly can on the minds of American yachtsmen that in my opinion no yachtsman can challenge from this side with the least hope of success. Experience, not merely mine, but that of my predecessor, has demonstrated this.

The remedy I suggest is very simple. But it must be borne in mind that the rules of measurement for international cup racers are not now applied to any other yacht races in America. New rules were adopted last year by the New York Yacht Club for its own contests, and if these were applied to the international cup races it would enormously facilitate matters for the challenger and competing yachts could then race under absolutely identical conditions. But as long as the old rule remains in force the results in the future will be the same as in the past.

As to the ocean race for the Kaiser's cup, that is in abeyance, so there is no need for my expressing any opinion about it.

Beyond that, I see no reason why the Gibraltar to Nice race for King Edward's cup should not prove very successful and the competition be fair to all concerned, as all the yachts meet on equal terms.

For myself, I really do not know whether I will challenge again for the America cup.

Commentaries on the Far Eastern War

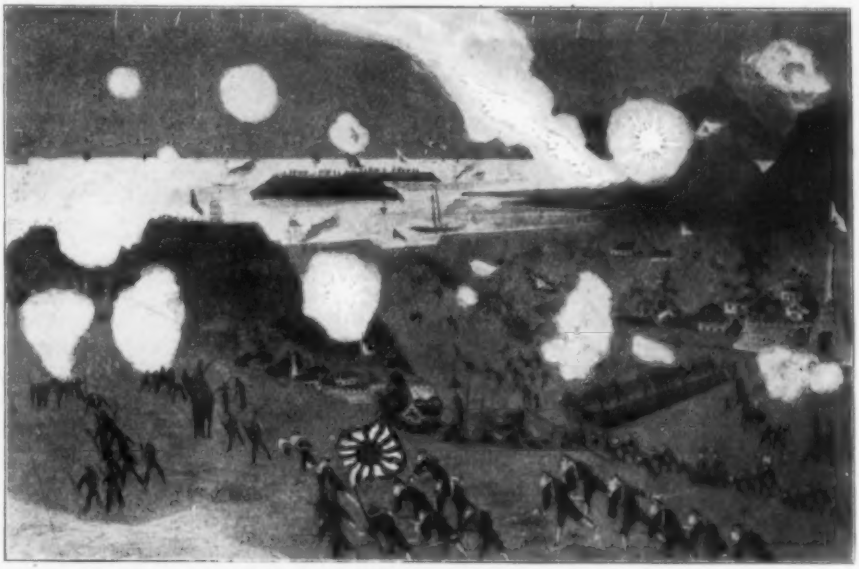
How Japan Worked While Russia Prayed--A War of Mechanics--Coaling at Nagasaki--Perils of the Battleship Stoker

By Paul Arr

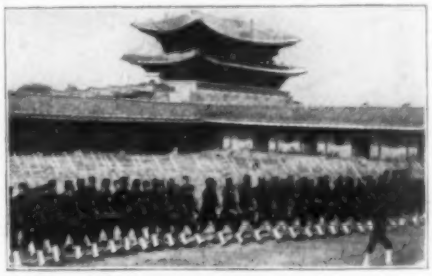
"But it is not believed that the Czar's desire for peace, nor the intercession of nations, can long avert the threatened war. Diplomats agree that it is an unavoidable event in the game of nations. Japan is only one of the chessmen that the British empire is moving to checkmate the great and accumulating power to the north and east and nearly everywhere—the Russias."—Extracted from Popular Mechanics, January issue.

And so the war, diplomatically regarded as inevitable, has come. It is a war in which mechanics will figure more than in any other conflict in history. In fact, its success depends not on the number of combatants of either side, but on the more powerful mechanical devices for inflicting destruction and death either can bring forth. Japan, having the more modern warships, submarines and shoulder arms, and a better knowledge of their use, has gained a big advantage in the start, but Russia has several powerful battleships now being built, and modern guns and other implements of war which are being put in service as rapidly as they can be obtained. Russia, in fact, was caught napping.

The Czar is at the head of the Greek church in Russia, and is very devout in his religion. Like his own Cossacks, who for more than a thousand years have made religion an excuse for war and pillage, the Czar makes use of public devotion to further the success of Russian arms. His first step after seeing war to be inevitable was to engage in lengthy religious services and to call on all his people to pray for the success of Russian forces. While Russia prayed, Japan, believing in Napoleon's maxim, that "God is on the side of the heaviest artillery," busied herself getting



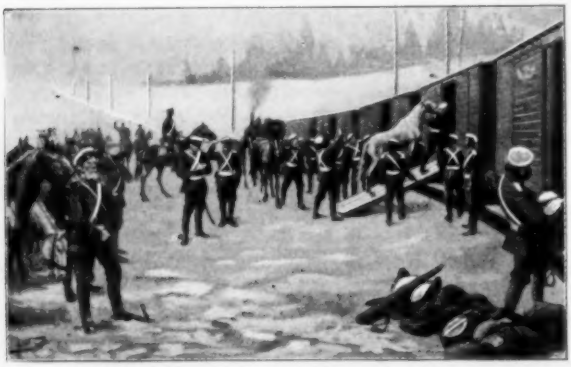
The Japanese Bombardment of Port Arthur--From a Sketch Made by a Japanese Artist



Korean Soldiers Marching Past the Palace Gate at Seoul

her ships and guns in shape and in striking wherever she saw an opening.

Christianity is the religion of Russia, and the principal churches are the Orthodox Greek or Russian and the Roman Catholic.



Entraining Russian Cavalry for the Far East on the Trans-Siberian Railroad

The cherished desire of the imperial policy, however, is for all the Russians to become amalgamated with the Russian church.

The Japanese are pagans, and deny the existence of a Christ. Their principal religion is Sintuism and Buddhism. In Sintuism they worship the sun goddess, of whom the mikado is supposed to be a direct descendant. No less than eight Buddhist sects exist in Japan, and images of Buddha are to be found in all sections.

But the Japanese do not put the faith in their idols that the Russians do in Christianity, and so have given but little time to religious preparation for the war. But Russia's movements are ever slow and determined, and it may be that her time to exult will come yet.

JAPANESE GUNNERS GOOD SHOTS.

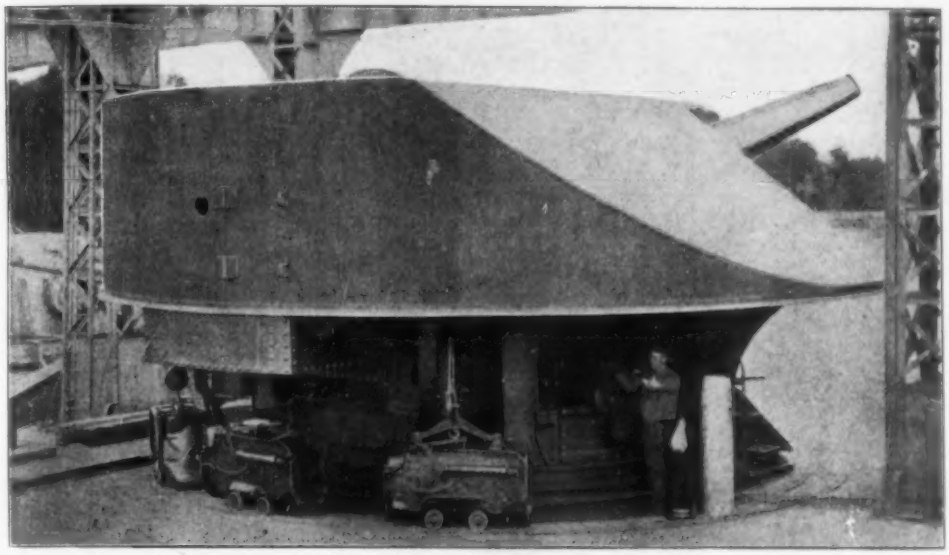
The Japanese gunners are said to be expert shots, quick in movement and accurate in aim. They have long been in training under the direction of some of the best artillery instructors in the world. A special feature has been made of light pieces for landing parties. One of these small guns is shown in the illustration. The gun itself weighs only 400 pounds, the carriage 700 pounds and the limber with 36 rounds 1,300 pounds. The piece throws a 12½ pound projectile 1,600 feet per second. The outfit can be taken almost anywhere and at close range can render good service.

The coast defenses of Japan are reported to be very complete, and well manned. Nature has furnished finer fortifications to this island than those possessed by any other nation in the world, and in many cases little work was necessary to make them strongly fortified. Some of these coast defenses are very heavy. In the illustration is shown one of the coast guns built by Krupp, and photographed at the works after erection for testing. It was then taken apart and shipped. This rotating turret houses a gun throwing a 981

A Japanese 3-Inch 12-Pounder Landing Equipment

Weight of Gun, 4 cwt. 14 lb.; ditto of Carriage, 7 cwt. 3 qr. lb.; ditto of Limber complete (with 36 rounds), 13 cwt. 6 lb.; Muzzle Velocity (foot seconds), 1,600; Weight of Projectile, 12½ lb. The Limber consists of a steel frame, supported on the axle by brackets and springs. At the rear of the frame is a hook for attaching the gun carriage when travelling, and the front is fitted to receive the pole, which is attached to the axle by means of a bolt.

pound projectile with an initial velocity of 3,038 feet per second. Electric or hydraulic power is used to rotate the turret, but in case of accident it can be turned by hand. The gun can also be loaded by hand power



A Krupp 12-Inch Gun in Rotating Turret Built for the Japanese Coast Defence Service

The projectiles weigh from 771 lbs. to 981 lbs., and their initial velocity attains 3,038 foot seconds. The maximum range at 22 deg. of elevation is 21,872 yards, and at 45 deg. of elevation 27,340 yards. The turret is rotated and the gun loaded by hand power, but either electric or hydraulic power can be applied, if desired.

should the other machinery become disabled. The small cars seen in the foreground are for hauling shells to be fired.

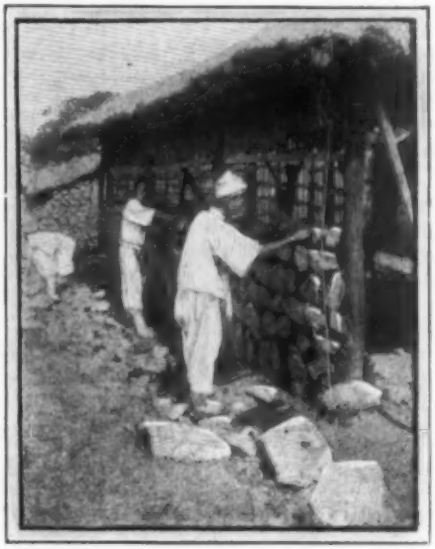
JAPAN'S PREPARATIONS.

Japan is certainly much better prepared than Russia. For months past her armories and naval stations have been beehives of intense energy. Russia, under the pretense of prolonged negotiations, sought to gain time and defer activities until the summer sun had unlocked Vladisvostock and made transportation across Siberia practical. The Czar personally, though a weak and vacillating person, wanted to avoid war, but his cabinet, army and naval officers did all in their power to force the issue.

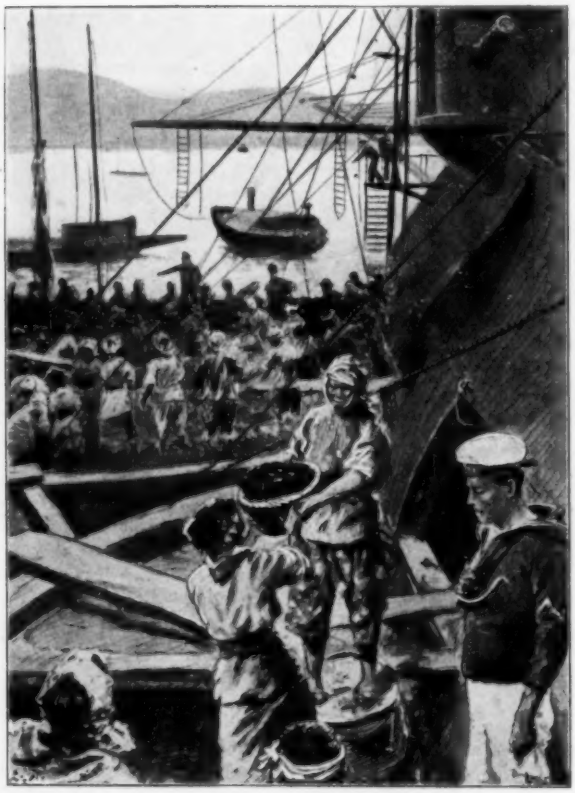
One of Russia's most serious obstacles in the war is scarcity of coal in the far East. Japan seized upon the time when Russia's coal bin was low to begin the war, and has succeeded in cutting off many sources of supply. Neutral nations cannot now permit Russia to coal at any of their ports, coal being contraband of war. Japan, on the other hand, is well supplied with coal. She has been storing up fuel for a couple of years.

HAS THE RECORD FOR FAST COALING.

Nagasaki, being in the heart of Japan's coal district, is the point where all the war vessels coal before starting on their journeys. Here is laid up a supply of coal



Building a House in Corea



Women Loading a Japanese Warship at Nagasaki

sufficient to last for years, and still strings of coal lighters may be seen daily going to and fro between this city and the coal mines on the neighboring islands. It is said that a vessel may be coaled quicker in Nagasaki than in any other port in the world, and here the loading is all done by hand.

Eliza Scidmore, the noted correspondent, writing from Nagasaki, says: "Coal is not put aboard as quickly in San Francisco, Tacoma, Seattle or Vancouver, with all the aid of overhead machinery and elevated tracks for coal cars, dumping directly to the ship's docks.

"All the mail steamers of the east, save the French Messageries Maritimes, coal at Nagasaki on outward and inward trips; all the naval ships fill their bunkers here, and once each month the American transports, home bound from Manila, stop to take on coal."

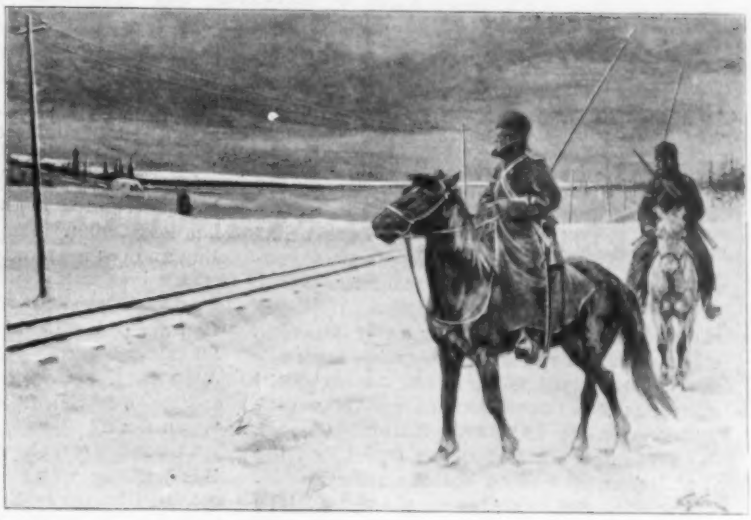
WOMEN, TOO, LOAD COAL.

Women, as many as men, engage in the work of coaling vessels at Nagasaki, and the celerity with which they work is a wonder to all who have ever witnessed them. The coaling is done by means of shallow baskets, which are filled in the lighters and passed rapidly from hand to hand until dumped into the bunker's mouths. The coal-passers are paid by the ton, and average about 30 cents a day, half price for women and children. During a deluge of rain these men, women and children put aboard a vessel 1,550 tons of coal in six hours. Frequently 1,210 tons have been put aboard ship in three and one-half hours. Recently 2,100 tons were put aboard in five and one-half hours, during which time each gang had a half-hour rest for their mid-day meal.

THE STOKER IN WAR.

The war vessel loaded, then comes the work of the stoker, who shovels coal into the fierce fires of the furnaces, twenty-five feet under the surface of the water, while the engineer officer below looks to steam and water gauges, to the precision of the stokers and the enginemen; and with them, unconscious of any peril that may threaten from the enemy, may rank in courage the admiral on the bridge. Recognizing the boiler rooms as the heart of the great war vessel of the modern navy, the boilers are placed in the center of the ship and surrounded by the coal bunkers. Overhead is a protected steel deck covering, and over this is a deck proper. As the armor of the ship dips only a short distance below the surface of the water, these decks are an especial protection to the boiler rooms and engine room. The bank of boilers may be twelve feet high, and the top line of this may be twelve or thirteen feet below the surface. Between these decks and the submerged armor there is protection against a direct shot, but to the stoker, far down in the blind boiler rooms, under thousands of tons of water, the armor-penetrating shell, fire, collision, submarine mines—all the dangers than menace the warship in an engagement are his, increased a hundred fold. His chance of escape in case of a sinking ship are one in a thousand. The glamour of the battle is not for him. The shout and huzzah of victory, or the grim, set face of one who sees his

defeat before the blow for him has struck—they are beyond him. He shovels coal and removes ashes, always with an eye to the steam gauges and the water gauges, and with an ear to the messages that may come from the bridge as to the progress of the fight—provided the commander has thought it necessary to report to the boiler rooms and engine rooms. And thus watching and listening, he shovels more coal and more ashes.



Cossacks, the Rough Riders of Russia, Guarding the Trans-Siberian Railroad in Manchura

BOILERS OF WAR VESSELS.

The water-tube boiler is almost universally used on big battleships. It is built in sections, consisting of tubes of comparatively small diameters, in which the water is held, the tubes lying horizontally in vertical, narrow piles, between which the flames and heat from the furnace fires pass directly, the result being, that, whereas a Scotch marine boiler of a certain horsepower might require two hours in which to raise steam to a working pressure, the water-tube boiler would do the work in half an hour.

In the water-tube boiler, also, the fact that it is built in sections makes it possible, in case of damage to one of the units, to have the unit cut out of the service without making appreciable difference in steaming power—a great advantage in time of battle.

Japanese Infantry on the March--The Japanese soldier is small in stature, but very wiry. His resistance of fatigue is remarkable, although his food consists only of rice and fish. He is intelligent and well trained.

America's Debt to John Hay

By Thomas D. Knight

The world resounds with the clash of arms in the Orient. Every roar of the gun, every stroke of sabre, every explosion of the torpedo against the side of the battle ship, is swiftly, surely, making history for all the future.

Since the sixteenth century Russia has been pushing its borders ever eastward, until its standards, starting from the Baltic dip in the waters of the Pacific. With the silent persistency of the glacier she has ground her way. When obstacles arise she has been content to wait, but no backward step has she ever taken in all these centuries. Russia has two distinct objects, born of her necessities—an outlet on the Mediterranean and an outlet on the Pacific. These she must have, before she can achieve the mercantile and military greatness of which her statesmen have so long dreamed—and so she waged a successful war with Turkey, but at the moment when she saw fulfilled her first great object, the other European powers intervened, and the blue waters of the Mediterranean still lie beyond her grasp. She has reached the Pacific, but her harbors there are ice locked through the winter, and she has looked with covetous eyes at the populous lands and open harbor of the Chinese Empire to her south. For this reason Japan was not permitted to reap the fruits of her victory over China a few years ago.

Russia wanted them for herself.

The outcome of the boxer uprising demonstrated the utter helplessness of China to defend her possessions against any warlike nation, and Russia had decided the time had come to partition China. The great Siberian railroad was pushed to completion and began to pour into sparsely settled Manchuria a stream of soldiers and settlers.

During these centuries of Russian expansion, a new nation had been born across the sea; a nation as different in its laws and government from Russia as day from night, a nation "of the people, by the people and for the people." First a little fringe of colonists along the Atlantic, it grew by leaps and bounds, until its standards also dipped in the waters of the Pacific at its other side. It acquired by purchase Alaska; it took from Spain the Philippine Islands; it began the great work of building the Panama canal, at the probable cost of a quarter of a billion dollars. It did these things in the full expectation that its merchants, its manufacturers and its farmers would develop and participate in the market of the Orient.

Russia was willing that America should be well treated in the proposed partition of helpless China. France, Germany and even England were more than complaisant. It was a critical moment in the history of the world—should America sanction the spoliation and take its share. At this juncture it announced through its secretary of state, John Hay, that America stood for the integrity of the Chinese Empire and the "open door."

The saneness, the honesty, the fairness of this position was instantly seen and acquiesced in by every European government except Russia, who, pretending to acquiesce, still continued pouring her soldiers and settlers into Manchuria.

But the policy thus enunciated by Hay had won its way so completely into the consciences of men that no nation dared to stand longer with Russia for spoliation, and England and Japan placed themselves in line with America's policy. Russia promised to evacuate Manchuria; she fixed a day to do so, but still she stayed. Finally, the little brown men grew tired waiting, grew weary of promises broken, of excuses and subterfuges, and struck—struck for the "open door" and the integrity of the Chinese Empire, for the policy enunciated by America through John Hay.

Having enunciated this policy, and two nations having gone to war over it, it became of great moment, whatever the result of the struggle, that the policy itself should not be imperilled thereby. Again America, through John Hay, assumes the leadership, suggesting to the other powers that an identical note be sent to the combatants, insisting upon the integrity of China, the "open door," and that hostilities be restricted to the territory of the combatants, and the territory in dispute.

This opportune announcement has already received the approval of Germany in addition to England and Japan. Surely England, Germany, America and Japan, when united are strong enough to guarantee the fulfillment of this policy.

Thus has John Hay, quiet, unostentatious gentleman, secretary of state in two great administrations, been the instrument

through which America has been able to make certain that her work in the past shall not have been made nugatory by the greed of any nation or combination of nations; and that the markets of the Pacific shall remain open to all the world, so that her future teeming millions shall have the opportunity to participate therein.

Giant Excavator That Digs Canals

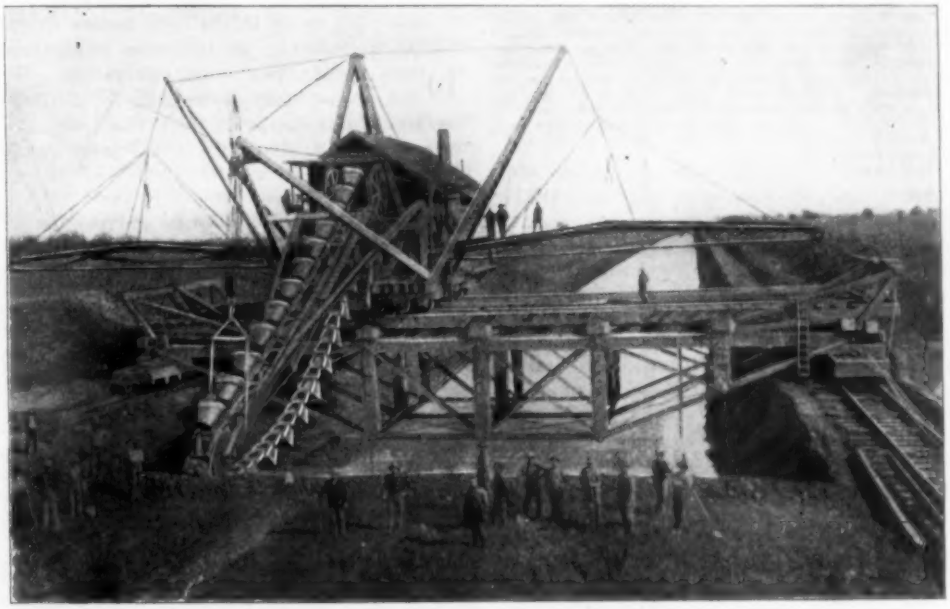
Does The Work of 1,000 Men Every Day

A thousand men toiling with shovels and wheelbarrows from sunrise to sunset could not accomplish as much work as the great steam excavator shown in the illustration performs in eight hours. The burning sun or rain in torrents has no terrors for this mammoth earth devouring monster. The scene is from a photograph of the construction work on the irrigation canal in Colusa county, California. The artificial river thus created is six miles long, 100 feet wide, and 35 feet to the top of its banks. The Sacramento river furnishes the water which makes fertile 156,000 acres of fruit ranches.

The excavator travels on its own railway tracks on each side of the canal, and as the work proceeds the track is taken up and relaid ahead of the machine.

The steel buckets which have sharp cutting edges move constantly by means of endless chains, and empty their load of earth first on one side then on the other. Wide endless belts carried on rollers carry the earth to the sides of the ditch.

All these movements of the machine are controlled by one leverman, who may be seen in the cut standing on the platform on the left of the bucket; he has control of five separate levers, one for raising and lowering the bucket chain, one for moving the car to the right, and another for moving the car to the left, and another for moving it forward on the side tracks, and the fifth controls the engine. The rapidity and facility with which all these movements are made is surprising, especially considering the momentum and immense weight of the car and bridge and the excavator's machinery, which is about 300 tons.



Excavating An Irrigation Canal

Lessons Taught by the Baltimore Fire

Danger of Frame Buildings and Overhead Wires--Necessity of High Pressure Water System

The Heart of Baltimore From a Photograph Taken After The Fire of February 7.--Courtesy the Chicago Chronicle

"America's buildings of all classes are the least substantial of those of any civilized country. Each class of buildings is improved after lessons similar to those of the Iroquois fire. The great Chicago fire of 1871 made Chicago's business houses more substantial. It will take time and hundreds of lives to give substance to our country's structures." —Extract from "Chicagoans Gave Their Lives for Our Protection," in the February issue of Popular Mechanics.

The Iroquois theater burned, killing 600 persons, and Chicago now has safe theaters. The city of Baltimore has burned and the Baltimore of the future will have safe buildings. All the theaters of America have been made safer as a result of the Iroquois fire. The burning of Baltimore will have a tendency to give better fire protection to all American cities. "It will take time" and lessons like these "to give substance to our country's structures."

Many lessons were taught by the Baltimore fire. It demonstrated that some of the supposedly fireproof steel skyscrapers were in reality combustible—another instance of terrible destruction resulting from over confidence of experts. Great office buildings alleged to have been proof against fire burned like paper and did nothing to check the flames.

The great lesson of the fire was the necessity of the high pressure water system, which with sprinkler attachments, furnishes a means of extinguishing a fire before it has a chance to attain dangerous proportions. This system, although expensive to install, would have saved Baltimore from destruction.

Another lesson taught was the great danger of overhead wires in cities. These so seriously hindered the work of the firemen in Baltimore as to permit the flames to attain such headway that it was impossible to check them. Baltimore was an old city, and the people disposed to adhere to time-honored ideals and customs. The buildings were generally firetraps. There were some steel structures but surrounded by frame shells, and throughout the city there were a great many wooden buildings and the buildings supposed to be of brick or stone were in many instances only pretenses with wooden frame and interior and brick and stone veneer. Such buildings are really more dangerous than all-wood structures and neither should be permitted in the business limits of a modern city.

Overhead wires have been cleared from the streets of many other cities, but in Baltimore a perfect network of them remained. No steps had been taken to remove any of them on account of the close connection between a political machine and the electricity producing and using corporation. The innumerable wires not only greatly hindered the firemen, but endangered their lives and also those of the spectators. Another serious hindrance in fighting the flames was the size of the Baltimore fire plugs. When the engines from other cities arrived they found their hose connections would not fit these plugs. This teaches the lesson that the fire plugs in all cities should be made adaptable to the engines of other cities which may be called upon in an emergency. This is a comparatively simple matter, but sometimes little, simple precautions prevent great disasters. Thus it is

seen that Baltimore's conditions seemed to work against the saving of the city and to the advantage of the flames. How many other cities are as poorly equipped?

The fire which destroyed 80 blocks of the city's heart and caused a loss of more than $100,000,000, was the first serious conflagration in which the skyscraper has played a part.

Men's efforts seemed powerless to check the progress of the flames. The very air seemed afire and as the parade of fiery tongues swept onward leaving devastation in their path, the fighters concentrated their efforts to confining the area of destruction to as narrow a district as possible. Great buildings were blown up with dynamite as a means of cutting off the flames, but they seemed to leap across the vacant space without hindrance and buildings were ignited blocks away. One by one these great buildings could be seen to reel and fall as the dynamite charges were exploded and then the fiery sea flowed over them without interruption.

The new Baltimore that is to arise from the flames is to be a model city. Its buildings will be fireproof and modern; all the wires will be run underground as they are in New York, Chicago, and all modern cities; the high-pressure water system will be installed, and the city will be laid out evenly and artistically. Baltimore has learned the lesson, but the cost was great.

Real Fireproof Skyscrapers Stood the Test

Great interest has been expressed as to the condition of modern steel skyscrapers in the Baltimore fire. The earlier newspaper reports had them all in ruins. The structures, however, seemed to have survived with serious damage to the interiors.

Mr. H. H. Glidden, manager of the Chicago Underwriters' Association, who made a personal examination of the ruins, says:

"All the steel structure of the fireproof buildings is standing intact with the exception of probably a beam or a girder here and there. The structure stands plumb with few exceptions and none of it is over an inch and a half out of line. As regards the covering of the steel work, it was found that brick survived the fire the best, and following that the best quality of tile. All stone work, the poorer tile, and granite have crumbled. Underwriters are viewing the Baltimore loss purely as the result of fire, as naturally there was but little water thrown. I would estimate the loss on fireproof structures at from 50 to 60 per cent."

Another report from a prominent manufacturer of fireproof building materials says:

"The first-class skyscraper, with skeleton steel frame, properly protected with fireproof material, is a structural success. The Baltimore fire has resulted in a victory for the modern type of fireproof building that had its origin in Chicago.

"Twelve of the skyscrapers are standing. They are as perpendicular as the day on which they were completed, though everything inflammable in them was burned—even to the nailing blocks. The stone and granite exteriors have been considerably damaged, but were not stripped off by the heat so as to expose the steel columns and cause them to warp and buckle.

"The Continental building suffered from the culminative force of the fire on four sides, yet it stands a triumph to the ingenuity of modern builders. The steel construction and fireproof material in the Calvert building is practically uninjured. In the Equitable building the only damage was to the steel arches, which instead of being protected with concrete were covered with wooden flooring.

"It was the hottest fire ever known. There must have been at least 2,800 degrees of temperature. Castiron mullions, typewriters, and plate glass were fused together. It was the same degree of heat as is found in a blast furnace.

"The fire has demonstrated that wood must not be used in a building intended to be fireproof. Highly finished woodwork is especially inflammable. For interior trimmings the only safe material is cement and imitation marble. All window frames and sashes should be made noncombustible."

What is to be the future of wireless telegraphy? What are the immediate improvements planned? Guglielmo Marconi, inventor of wireless telegraphy, will have something to say about this subject in next month's Popular Mechanics. You ought to read it and there will be many other enlightening articles in next month's Popular Mechanics, all written so you can understand them.

Great Interest in Motor Boat Racing

Racers With Automobile Engines Being Built and Preparations Made for a Lively Season.

From New York comes the information that the coming season is to develop unprecedented interest in motor boat racing. Prominent eastern yachtsmen are planning for contests and builders are busy constructing racers. More than one-half of the work now in the hands of builders is in launch or steam yacht hulls, with the type built for speed to be fitted with automobile engines, a new and important feature. The boom in the sport is due not a little to the formation of the American Power-Boat Association, and the method that organization has pursued in placing the sport on a sound basis. Rules of measurement and rating were adopted which brought order out of chaos. A trans-Atlantic steam yacht race has been suggested, but there are doubts that it will occur this year.

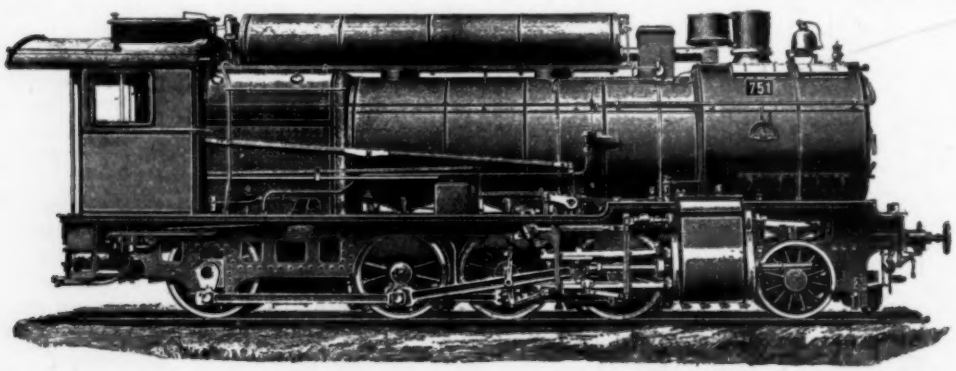
Prominent in the line of launch racing is the first competition for the $1,000 trophy offered by the American Power-Boat Association. This is to be a perpetual challenge cup, open to boats belonging to any recognized yacht club in the world, except that such club, if located in the United States, must be a member of the association. Boats must not be less than 25 feet water line and must rate not less than 35 feet, under the measurement rules of the association.

Great interest is being manifested in the match arranged for auto launches to take place under the rules of the American Power-Boat Association between March 15 and May 15. It is to be between the Vingt-et-Un and a craft to be built by C. H. Tangeman. The Ving-et-Un is a 30-foot speed launch of the extreme type, designed by C. H. Crane and built by "Tom" Fearon, once a noted oarsman and shellboat builder and a very clever workman. The motor is of the car type. It has four cylinders and is of 21 horse-power. The weight of hull and motor is only 770 pounds. In the trial trip the boat made a record of a mile in 2:36.

The race is to be for a stake of $1,000 a side for any distance from 20 to 40 miles on the Hudson or the Sound. The challenger will be powered with a motor of 24 horse-power. The boot will be 35 feet over all and will be designed and built by the Electric Launch Company of Bayonne, N. J.

FREIGHT LOCOMOTIVE FOR SAXONY.

Compared with the standard American locomotive, the type used in Saxony presents a strange contrast. The illustration



shows the style generally used in that country for hauling freight. These engines have eight driving wheels and are compound. A striking feature is the superheater for steam used in the low pressure cylinder. This heater is concealed from view, being located below the stack and using the otherwise waste heat. An increased efficiency of 10 to 20 per cent is claimed. The steam is reheated in the smoke box, while passing from the exhaust of the high pressure cylinder to the low pressure cylinder. The hinged smoke stack is for clearing low tunnels. The engines weigh 80 tons.

Lassa, The Forbidden City Entered

Remarkable Condition Discovered by a Daring Russian Who Disguised as a Priest Makes His Way Inside the Sacred Walls

The mysteries of Lassa, the forbidden city, have at last been explored. Disguised as a Buddhist pilgrim M. Ushi Narzounof, a Russian, entered the Tibetian city, took snapshots of the buildings and people and has given to the world a remarkable account of the strange and astonishing conditions existing within the walls that have excluded the emissaries of civilization for nearly a hundred years. These snapshots, some of which are herewith reproduced, are the first pictures of Lassa ever obtained. The daring Russian's success is especially interesting at this time owing to England's proposed invasion of Tibet, of which Lassa is the capital.

For centuries past nearly as many attempts have been made to reach Lassa as there have been to reach the North Pole, but none of them before have been entirely successful. True, several white men, through daring and ingenious strategy have made their way inside the walls, according to their claims, but fear of detection caused them to fly before the desired information was obtained. The Russian Narzounof seems to have explored the city at will; he gathered secrets regarding the affairs of government; took photographs of many scenes, even of the Lama's residence, and learned much of the strange manners and customs of the residents. He was a novice with the camera and consequently his pictures are crude, but being the only ones ever obtained of the most mysterious city on the globe, they are regarded as priceless.

Lassa has been called the White City of Mysteries. It is to Buddhism what Rome is to Catholicism. It is the headquarters of the hierarchy of lamas, the Buddhist priests or monks. There dwells the dalai-lama, who up to the time of Narzounof's visit, was supposed to exercise priestly control over nearly all Mongolia as well as Tibet. Narzounof discovered that the delai-lama is merely a figure head, in truth a titled slave and that the Chinese viceroy is in reality king of Tibet and Mongolia. The city lies in a fertile plain, extending about 12 miles from north to south and about 125 miles in length. A Chinese garrison is quartered near Mount Botala, whose temples are resplendent with

M. Narzounof, the Russian who, Disguised as a Priest has Entered Lassa, the Forbidden City, and Given to the World the First Pictures Ever Obtained of that Strange and Unknown Municipality.

gold and precious stones. Since the expulsion of the monks of the Capuchin mission in 1792 no foreigners have been allowed entrance into Tibet from the south and none but pilgrims from the north.

Tibet is a great plateau in Central Asia. It is bounded on the north by Mongolia, on the east by China and on the south and west by Hindustan. The natives call it Bod or Bodyul, the land of Bod. It has an area of about 800,000 square miles, the northeastern part of which is yet entirely unknown to civilization. Its population probably amounts to 10,000,000. It has a mean elevation of nearly 16,000 feet above the sea level and has been called the "roof of the world." Its latitude is about the same as Egypt or Florida and it might be supposed to enjoy a tropical climate, but owing to its excessive

These Illustrations are From the First Photographs Ever Obtained of Lassa, the Forbidden City

1.—Street Scene in the District Inhabited by Lassa's Poor. 2.—A Typical Lassa Home. 3.—Method of Delivering Goods in Lassa. 4.—Palaces and Grounds of the Lamas

altitude its climate is as cold as the arctics.

The approach to Lassa from every side is guarded by almost insurmountable obstacles. Tibet itself is embraced by the Himalaya, the Kuen-lun and Altan-tagh mountain ranges. Besides these mountain ranges, the loftiest in the world, the northern and western frontiers are guarded by the Tarim and Gobi deserts. Such is the seemingly inapproachable region that the Buddhists centuries ago chose as their religious capitol. Five hundred million Buddhists are governed by the lamas, that receive their orders from the Lassa Holy of Holies.

Narzounof made the journey to Lassa in company with Mongul, Buriat and Kalmuk pilgrims, Russian subjects of the Buddhist belief. They make yearly journeys to Lassa for which facilities are accorded them by the Czar. Narzounof successfully carried out his guise as a priest and was never detected during the entire pilgrimage to and from Lassa. At the time of his visit the pilgrims in Lassa numbered 10,000.

Tibetian Method of Accustoming Souls to the Demons of the Lamas

Narzounof found the mechanical appliances employed at Lassa of exceedingly crude construction, not unlike those of China. The architecture, however, was pleasing to the eye and of exceedingly substantial build. The vast concourse of buildings and temples, he says, is at once a citadel and a palace crowning the sacred mountain Mar-bo-Ri. The temples Narzounof describes as being magnificent edifices, all of gilt roofs. They lead up to the Potala, the residence of the delai-lama, the head of the Buddhist religion. It seems that the city's resources are derived nearly exclusively from the vast throngs of Buddhist pilgrims that visit the city every year and that little commerce is carried on in the holy municipality.

Narzounof found that the dalai-lama, who is supposed to govern absolutely all of Tibet and the Buddhist church everywhere, is really a prisoner in the great temple, the picture of which is herewith shown, and which was built by the ancient kings in the seventh century. This temple, or the Potala, stands on a sacred hill overlooking the city. Narzounof made extensive investigations into the affairs of Lassa's government and has made some startling discoveries. He learned that during the last century nearly all the dalai-lamas (grand lamas)

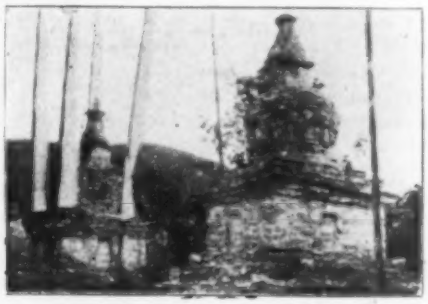
have died in infancy. He believes that they were put to death by the ruling oligarchy of lamas to prevent their having any active influence in governmental affairs.

The Russian learned that when the dalai-lama dies his successor is chosen from among three youths not yet out of their teens. The Chinese emperor reserves the right to veto the election of the dalai-lama whenever he so desires. The death or sudden disappearance of a lama are of frequent occurrance in Lassa, but it is the position of the lama and not the person that the pilgrims worship and they probably rarely ever recognize the countenance of the lifeless looking being before whom they prostrate themselves in the temple. Narzounof declares the only duty of the lama is to sit adorned in gorgeous robes cross-legged before the idol of Buddha, while the pilgrims kneel and crawl before him. He says that the lama seems nearly as lifeless as the great jeweled idol below which he sits. He claims that the child is drugged before taking his seat at the idol's feet, in order to make him appear ghastly, weird and unnatural. This continuous drugging, he says, robs the poor youth at all times of all his natural impulses and inclinations and makes him appear inhuman.

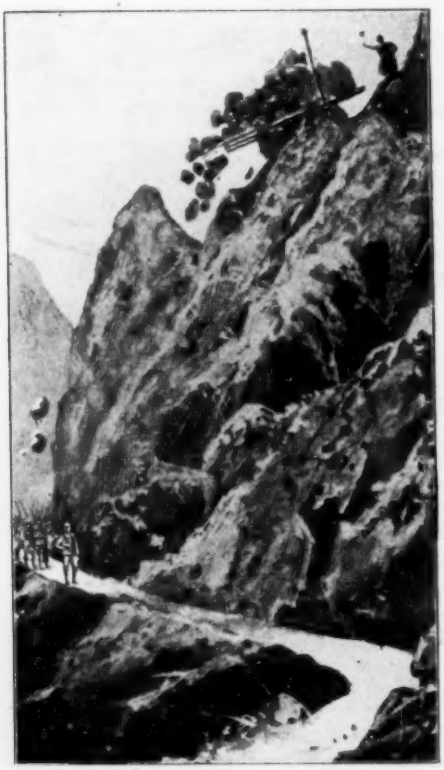
Group of Residents of Lassa

A Lamassory Crowning the Hills Overlooking Lassa

The Potala, where this ceremony before the dalai-lama takes place, is described as the largest palace in the world. Narzounof declares that it contains more than 3,000 rooms. One of the facades is nine stories high. It contains an enormous collection of Oriental art works and the largest library in the world. Here is located the "Kanjur,"

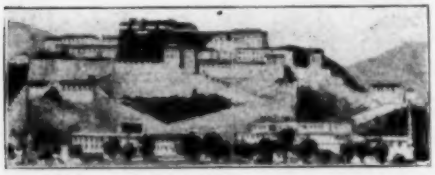


Tombs of the Lamas



A Tibetian Booby Trap.—A Rope Which Holds a Teetering Platform Loaded With Rocks is Cut and the Rocks are Precipitated in Showers on the Enemy Marching Along the Mountainous Paths En Route to Lassa

comprising more than 100 enormous volumes, said to be the direct word of Buddha; the "Tanjur," comprising 225 volumes and the Mam-kambum," or book of 100,000 volumes. The latter was compiled by Srong-Tsan-Gambo, the adored reformer of Tibet, and contains the secular law of the land. Narzounof confirms the former assertions that rites of the Masonic society are practiced in Tibet.



Home of the Dalai Lama—The Largest Palace in the World

Narzounof tells of many weird and strange customs performed by the pilgrims visiting Lassa; he describes their remarkable pigrimages over the mountains and deserts; relates their religious observances in Lassa, tells how they roll themselves on the walks, crawl on all fours around the city's walls, etc.

Expeditions that have attempted to reach Lassa before have either been baffled by the lofty mountains and blighting deserts or have been forced to retreat their steps by orders of the lamas. Dr. Sven Hedin recently attempted such an expedition. After many thrilling experiences he approached within 200 miles of Lassa. Then he was met by Tibetian soldiers, who forced him to retrace his steps; furnishing him an escort with abundant provisions to last until he was beyond Tibetian territory.

Other mysteries of Lassa and Tibet will probably be revealed in the near future as a result of the proposed British invasion, which will undoubtedly be the most interesting event of the kind in modern history. The English expedition is commanded by Col. Younghusband, of long experience in Oriental matters. It recently crossed the Himilayas into Yatung. The dalai-lama made no remonstrance and so the expedition has now advanced to Gyang-tse towards Lassa. This is within 49 miles of Shigatze, a holy city only second in importance to Lassa. According to late advices the expedition has here been checked by the Tibetian soldiers and Col. Younghusband has been forced to send back to India for reinforcements. Russia and China are greatly opposed to England's invasion of Tibet, but the British government has announced that it will not recede from its policy and proposes to open Lassa to the commerce of the world.

HAUL PASSENGERS BY THE POUND.

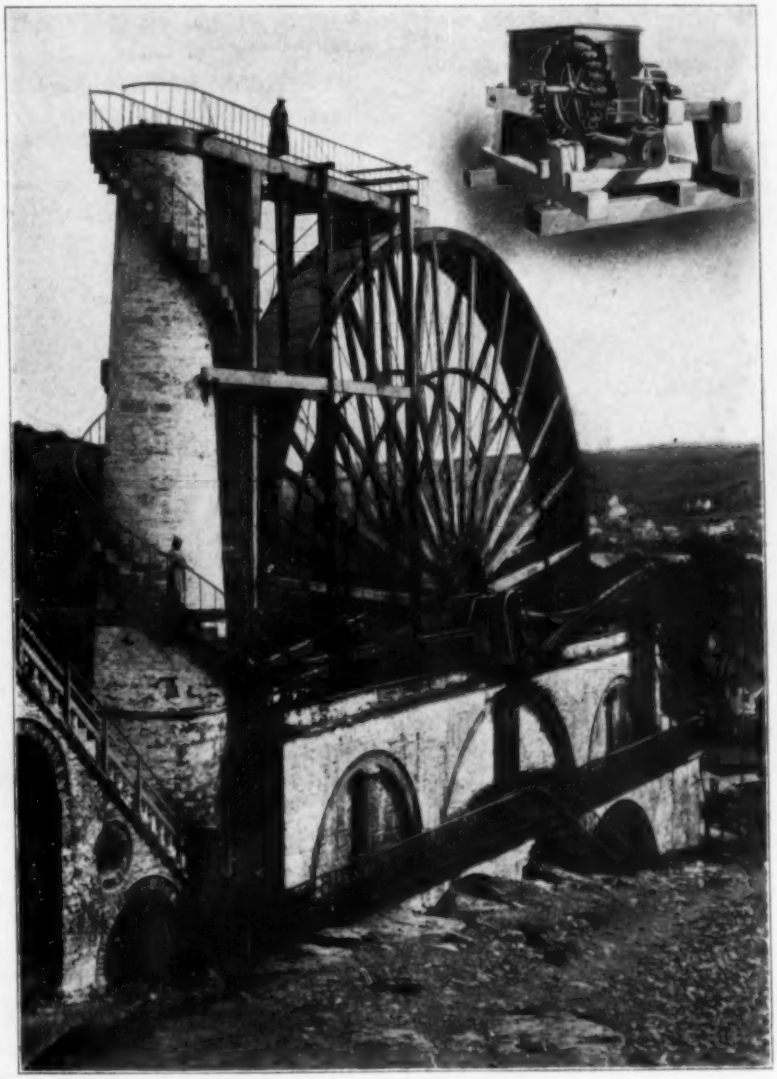
An official of the new Pueblo & Beulah Valley Electric Railway in Colorado announces that when the road is completed each person will be required to step on an automatic register scale at the ticket office and the clerk will charge for transportation at the rate of 1½ cents a pound.

This is right. Why should a small, lean man pay as much to ride on a railway car as the bulky individual of large girth and weight? The man of much adipose not only takes up more room but it certainly costs more coal or electric energy to haul him. This is an indication of the good times coming when the railroad can figure just what it costs per ton per mile to haul "freight".

The World's Two Greatest Water Wheels

Monster on the Isle of Man Has Been Running Forty Years—Troy, N. Y., Boasts the Second in Size

At the little village of Laxey, on the Isle of Man, off the west coast of England, stands a monster water wheel, that hundreds of persons every year go miles to see. It is the greatest water wheel ever built in the history of the world, and during the forty-five years of its existence has been running continuously. It is an overshot, or gravity wheel, a type now rapidly becoming extinct. The less picturesque, but far more useful and economical, turbine wheel, a product of the United States, is supplanting



The Great Overshot Wheel at Laxey on the Isle of Man, England.—Copyrighted by the Pelton Water Wheel Co.

the imposing looking overshots, much to the disappointment of the artist, but to the delight of the manufacturer.

The Laxey wheel is 72 feet 6 inches in

diameter. It develops 150 horse power, which is transmitted several hundred feet by means of rods having supports at regular intervals, to the bottom of which are attached small wheels, running on iron ways, for the purpose of lessening friction. The power thus transmitted operates a system of pumps in a lead mine, and 250 gallons of water per minute is raised to an elevation of 1,200 feet.

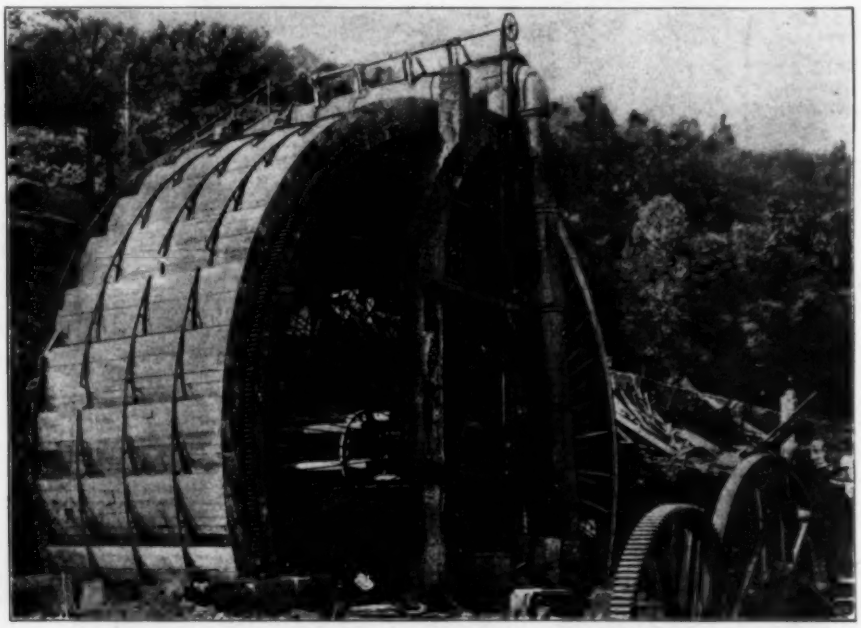
The water to drive the wheel comes from a distance in an underground conduit, and is carried up the masonry tower by pressure and flows over the top into the buckets. This wheel was built forty years ago, and has been running continuously every day since, never having lost a turn.

The little, unpretentious appearing machine in the upper right hand corner of the picture on page 329 shows what the present day has contributed to supplant the grand old faithful structures whose ponderous machinery, massive columns, arches and stone foundations were so pleasing to look upon.

These two wheels bear exactly the same proportion to each other in size as do the pictures, and although a mere toy in comparison, the little wheel has exactly the same capacity as the Laxey wheel, the largest in the world. The wonderful increase in power of the little American is due to the peculiar shape of the buckets into which the water is directed from one or more nozzles, so that the full energy due to its head or fall is transferred into the inertia of the wheel. The power represented by the force of the water is thus converted into mechanical movement almost entirely without friction. The buckets simply take the energy out of the stream and leave the water inert to fall beneath the wheel.

LARGEST WHEEL IN AMERICA.

Next in size to the great Laxey water wheel is the Burden wheel of America. This



Old Abandoned Burden Water Wheel

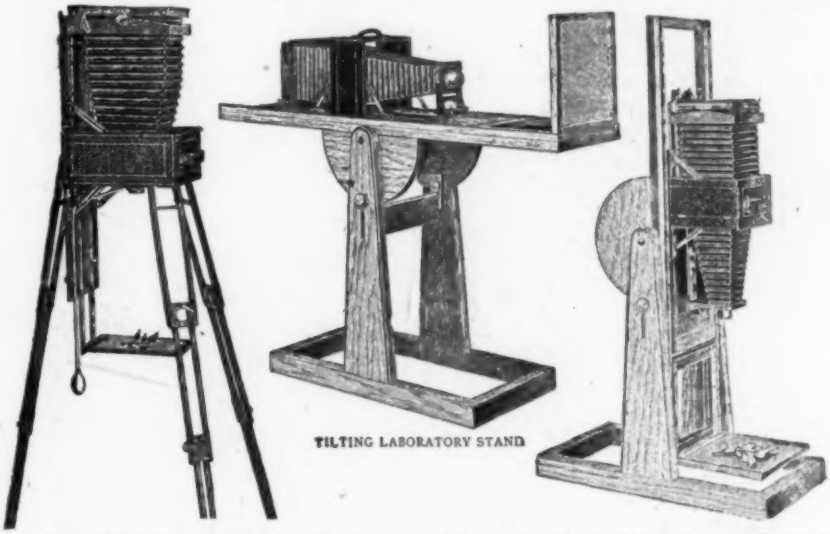
is at the old Burden works, Troy, N. Y. The wheel is 60 feet in diameter at or inside the buckets. The 36 buckets are 12 inches radially at the top, running to point at the bottom, and 4 feet deep circumferentially. The gear rack at each side is 9 inches face and 4½ inches pitch. The journals or trunnions are 16½ inches diameter by 18 inches long. The rods or spokes are iron, 1½ inches in diameter. There are 22 rods in each section, or 254 in all.

The wheel was built in 1848, and continued to run until 1896. It was doing good work when the old plant was abandoned, never to be resumed again. The wheel

stands today as its designer built it, with the exception of new racks, which were put on about twenty-one years ago. The wheel made two and one-half turns a minute and furnished power for the entire plant. The plant consited of one rotary squeezer and muckbar train, five 9-inch trains for rolling horseshoe and rivet iron, four horseshoe machines, six rivet and spike machines, thirty punching machines, a machine shop, roll lathes, shears and all the other machinery called for in a rolling mill.

THE NATURALISTS CAMERA.

The Naturalists camera was first made to fill an order from one of the scientific departments of the United States government. It has since come to be generally used by professors in colleges and others desiring photographic work of this character.



TILTING LABORATORY STAND

The outfit at the left is for outdoor work. The other, shown in two positions, is for laboratory use. Any of our readers could build from an examination of the picture a tilting set for home work, using their own camera for the purpose.

A method yet more simple, says Photo-Beacon, is to suspend the camera by four strings from the doorway. This answers where only an occasional exposure is required.

In Switzerland water fall have been harnessed for the production of electrical power to an enormous extent. There are now 140,000 electrical horse-power in daily service.

ONE TON OF COAL DOES THE WORK OF 40,000 MEN.

Remarkable Statement of Dr. John Perry in a Public Address at Oxford, England

"Are you aware that from one ton of coal there is as much energy, as much actual work, as may be done by 40,000 good laborers in a ten-hour day? Our best steam engines utilize only one-tenth of this energy at the present time. But even now we know that the cost of the most unskilled work done by man is one thousand times the cost of the same work wherever it may be done by the best steam engine. One fact of this kind, properly considered, is worth many long essays about the effect of the engineer in altering all the character of our civilization." These facts are contained in an address recently delivered at Oxford, England, by Dr. John Perry.

"Man is utilizing the energies of nature in thousands of ways unknown to the ancients. Common people are all getting educated. Where the ancients wondered and trembled, we understand and give orders to nature. The average unit of any population was compelled to be what we now call an unskilled laborer.

"Now our labor is becoming more and more skilled. It is labor that is the true standard of wealth. The steam engine has added incalculably to the wealth of the world. We forget that man is no longer needed for unskilled labor, so that when we use unskilled labor we are using the materials which God has given us in the most inefficient manner possible."

Great Buildings of America

The First National Bank Building, Chicago

Costing $5,000,000 containing 18 acres of floor space and 10,000 tons of steel construction, the new First National Bank building of Chicago, which houses more than $100,000,000 depositors' money, is the latest addition to Chicago's big array of skyscrapers and is one of the most magnificent buildings in the United States. Its splendid granite walls facing Dearborn and Monroe streets rise 18 stories high in majestic simplicity, the only ornamentation being slightly projecting sill courses. A marble hall of Romanic splendor is the interior space containing the First National Bank, the second largest financial institution in America. The bank occupies the space contained in the first three stories. The aggregate height of these three lower stories is equal to that of an ordinary five story building. A cornice supported on massive Doric pilasters, forty feet high, incloses the arched openings of the bank proper. Through an archway the main entrance to the main banking room leads into the grand central court. This court with its marble walls and marble seats and crystal plate glass dome fifty feet above the floor is one of the most imposing interiors to be found in any land. The court measures 60 by 90 feet and is surrounded by an arcade. The main banking room is 230 feet long, 190 feet wide and 47 feet high, 15 feet of the height facing the court being divided off into a secondary floor. There is one acre of floor space for every story. This space is divided off into offices and corridors, the corridors on every floor extending entirely around the building. The building has a frontage of 231 feet on Monroe street and 192 feet on Dearborn street, the total area being 44,274 square feet. Its height is 257 feet. There are 1,800 windows in the structure and 1,020 doors. These furnish light and egress and ingress to 983 offices. Like a city within itself the building contains its own electric lighting plant, the boilers of 800 horse power furnishing power for the 7,900 electric lights and for the running of the fourteen elevators. There is a two-story basement underneath the structure where is located the power plants, the printing offices, and other departments.

Machine Enables Us to "Feel" Music

Passes Waves of Harmony Through the Body--Is as Pleasing as Hearing

To say that you can hear a loud necktie, or see it thunder, seems scarcely less ridiculous than to say you can "feel" a new piece of music being played, yet the latter is made a reality through a new contrivance that has just been invented. Maybe the inventor's next step will be to enable us to smell the music.

"Feeling" music is made possible through an electrical device, called the "vibrochord," by which the sound is made to affect the patient's sense of touch as well as his sense of hearing. Those who have experienced the new sensation declare that music "feels" as good as it sounds and that there is all the difference in the world in the feeling of a pretty air and an ugly one. Different persons like the feeling of different tunes. Some declare "rag time" feels better than any other, while cultivated tastes prefer the feeling of classical music.

Feeling and Hearing the Piano Play

In "feeling" music the sound is conducted from the instrument to the person by means of electric wires. Instead of the sound waves merely knocking on the tympanum of the ear, as in listening to music, the waves of harmony course clear through the body, so that the tune is felt from head to foot. The device can be attached to any kind of musical instrument, so that we can feel a piano, phonograph, guitar, banjo or an organ play, or feel the blowing of a cornet or a trombone, and if a wire could be attached to every horn we could feel the music of a brass band. Those who have practiced "feeling" music have demonstrated that they can easily discriminate between the feeling of different airs as well as of different instruments. They could readily distinguish the feeling of "Home, Sweet Home," from "My Ragtime Chinaman," although they were separated from the instrument by walls so thick that the music could not possibly be heard.

This feeling of music is declared to have wonderful healing powers. It is prescribed by its inventor for insomnia, hysteria, nervous prostration, rheumatism and numerous other ailments.

The vibrochord is inclosed in a case con-

taining coils and magnets with electric wires extending to the musical instrument and to the patient. Two handles connected to the wires are to be held in the hands and the feet rest on a metallic plate.

Fred H. Brown, inventor of the music feeling machine, says: "Whenever the vibrochord is used, the human body virtually becomes a part of the instrument and does and must respond to the harmonic vibration of the instrument. The induction coil is so arranged as to utilize the harmonic beats; consequently the electric pulsations also occur in harmonic time." The intensity of the musical vibrations can be regulated to suit the person.

CURRENT MILLS ON THE DANUBE.

Floating flour mills, without steam engines to drive the rolls, are familiar sights on the lower Danube. The river has a swift current in which the barge mill is anchored.

This mill is made up of two barges with a great paddle wheel between them. The large barge contains the grinding machine, while the smaller one is merely a support for the other end of the wheel. The mill is anchored in the river, somewhere within the wheat region, and the grain in bags is brought in ox carts to the edge of the water, where it is put into small boats and rowed

Floating Flour Mill

to the mill. When all the wheat in one district has been ground into flour, the mill is floated up or down the river to other parts of the region until all of the grain has been converted into flour.

Milling done in this way is not as slow as we progressive Americans might suppose. The current of the lower Danube is very swift; and as the mill is moored in midstream, so that the full force of the water can act upon the wheel by which the grinder is operated, its revolutions are very rapid and powerful, and large quantities of the grain are milled daily. The larger boat serves also as the home of the miller and his family.

The flour made from the wheat grown on the Hungarian Plain is thought to be of such excellent quality that European bakers will pay nearly any price for it.

HIGH PRESSURE GAS DISTRIBUTION.

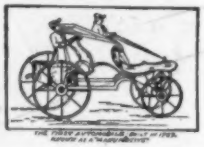
A system of high pressure gas distribution is being constructed in St. Louis, by means of which gas will be pumped long distances. The practice which has been used in natural gas lines is now to be applied to the transportation of ordinary illuminating city gas. The entire city and adjacent territory covering 65 square miles is to be served. The method has a striking similarity to the distribution and transformation of high tension electric currents.

A 300-horse-power blower will force the gas at 80 pounds pressure through specially constructed mains from which it will be supplied to the street service mains at five pounds pressure. By this method a comparatively small main will conduct a volume of gas which under the old system would require pipes of enormous size.

THE FIRST AUTOMOBILE.

Its Velocity Depended on the Activity of the Footman

The enormous contrast between an automobile of 130 years ago and of the late Parisian types as exhibited at the Paris show, is exceedingly startling, yet it is little greater than the difference between these late types and the machines of only 20 years ago.



The "manumotive" shown in the illustration, was built in 1769. The drawings for it were described as "Mechanical projections of the traveling chaise without horses, showing plainly, by inspection, the constitution of the machine. By John Vevherf, Master of the Boarding School of Rygate, in Surry."

The machine was worked by a footman who, stationed in a box in the rear, stood on levers and by alternately depressing each of them, propelled the vehicle by a rack and pinion arrangement, the descending lever raising the other one. The driver steered by reins, "and by the most complicated and indirect system imaginable." The description concludes with a very terse, self-evident truth—"The velocity of these carriages depends on the activity of the footman."

Dangers of Smokeless Powder

Smokeless powder has its dangers as well as advantages. While it does not reveal the location of the guns from which it is fired, and does not obstruct the vision of its gunners, it does emit a most deadly gas, which, if confined, works havoc. When used in the open field or battlements there is usually enough wind blowing to carry away the fumes, but when fired from turrets on board ship the gases are liable to be blown back into the compartment. In recent target practice by a battleship the wind blew the fumes into the turret and nearly asphyxiated the entire gun crew.

The symptoms as described by the Journal of the American Medical Association were: Convulsions, labored respiration, small and irregular pulse, feeble and tremulous heart action, headache, loss of consciousness, etc., and were ascribed in a large measure to the nitric and nitrous products created by the combustion. It, therefore, becomes in part a problem of ventilation. The ship crews must be protected from these fumes by proper devices.

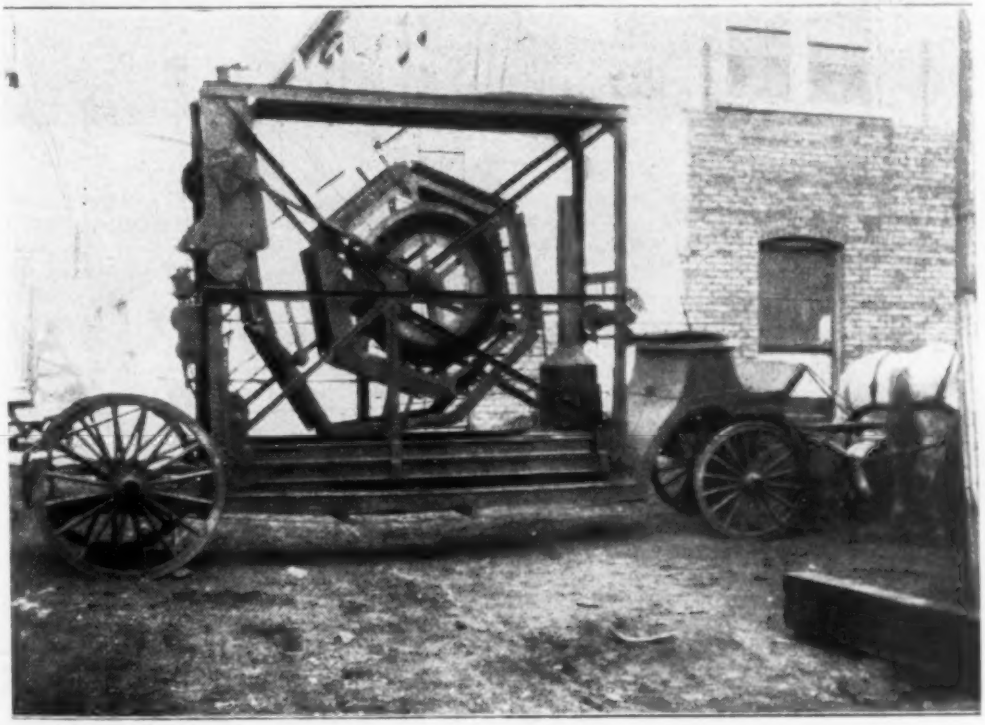
Torel, writing on this subject, calls attention to the fact that under certain circumstances smokeless powder may be more of injury than of benefit to the ship crew using it.

Novel Winding Fire Ladder

Coiled Round a Drum and is Hoisted to Top of a Burning Building in Ten Seconds

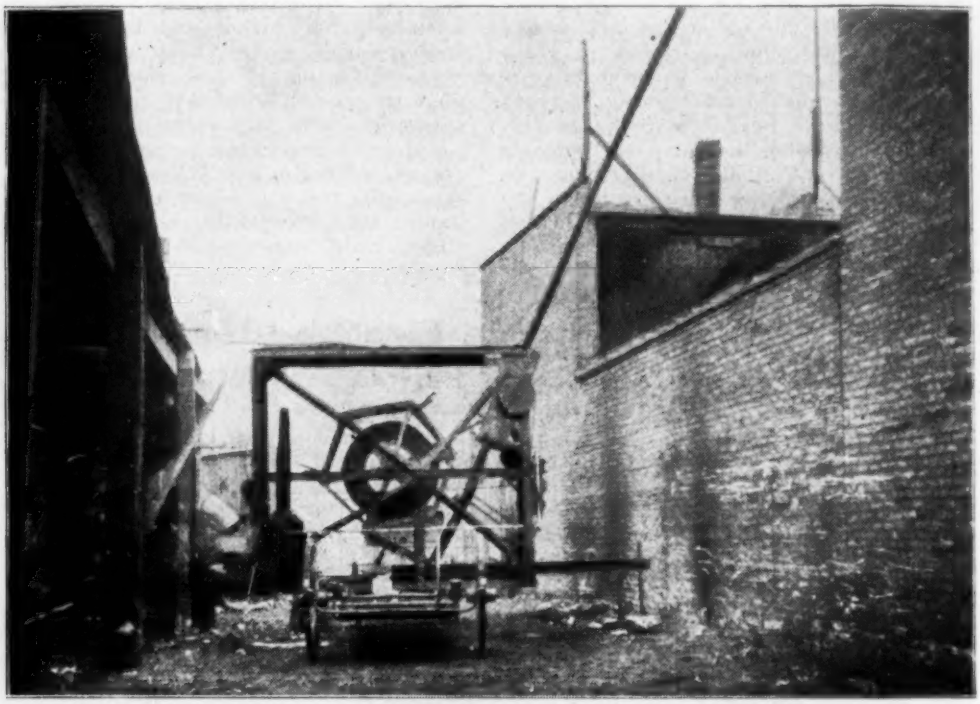
A fire ladder that is unwound from a drum and carrying two men with it shoots up to the top of an 80-foot building in 10 seconds, is a new and novel contrivance that has made its appearance in Chicago. It has been named the Copelin fire ladder.

The Western Fireman says: "The ladder is constructed in sections arranged round a drum and is shot up by the force of a small engine attached to the apparatus, the



Fire Ladder Closed

sections of the ladder locking automatically as it is raised. The apparatus revolves on a turn-table so as to give greater compactness while traveling through the streets. On arriving at the fire it is easily turned



Fire Ladder Extended

and a wide and secure base quickly established by the drawing out of supports. The apparatus is constructed entirely of steel. It will carry two men, each with a lead of hose."

The illustration shows the fire ladder and truck on which it is carried, in a 16-foot alley, in which it can be turned round without difficulty. The patent has been acquired by Chicago capitalists.

A GOOD PIPE CEMENT.

A recipe for a good pipe cement for use on all classes of work up to 160 pounds pressure in air, steam or water, is given in the Engineer. To 2 pounds of powdered graphite add ¼ pint of prepared white lead and mix the whole with sufficient boiled linseed oil to make a thick paste. Apply preferably with a small stiff marking brush and keep well stirred while in use. If it thickens, add a little more oil.

RUBBER BILLIARD AND BOWLING BALLS.

Bowling balls and billiard and pool balls are now being made of hard rubber, and the attention they are attracting seem to indicate that they are destined to supplant the time-honored composition billiard ball and the lignum vitae bowling ball. A set of the billiard balls made by Richard Mason, an American, were recently sent to London, where they attracted considerable attention.

The London Mechanical Review says: "The balls are now in use in a pool and billiard room here. Apparently they are every bit as 'lively' as the ordinary pool ball, and experts who at first play with them can hardly be made to believe that they are rubber."

The India-Rubber World says: "The rubber bowling balls do not crack or chip, as do the lignum vitae balls, and when bowlers once get accustomed to them they will use no other."

WHO KNOWS?

One of our readers, H. B. Kean, Stanley, N. Y., wants the address of the Gilliams Western Foundry, which ten years ago were making a portable forge.

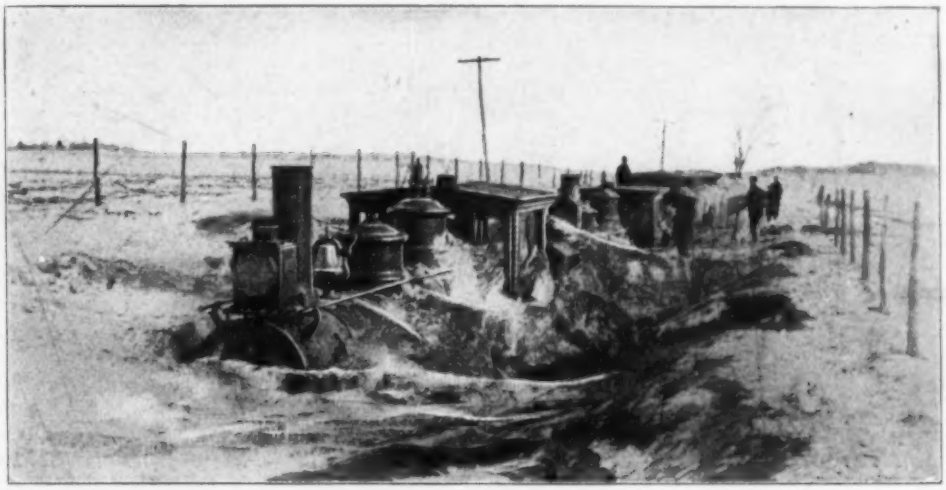
Trains Buried in February Snow

Another Month of Cold and Storms Works Havoc on American Railroads

First Engine Stalled: Second and Third Wrecked Engineers Killed

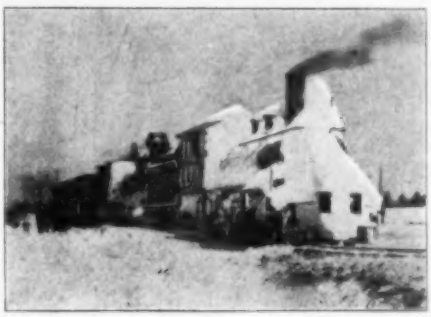
tied up completely on many lines and the most powerful snow plows in existence fought for days and nights uninterruptedly against the overwhelming odds. These snow plows, however, saved many lives, rescued many trains from threatened destruction in snow drifts and prevented a total suspension of traffic on many lines. The severity of the 1904 storms has demonstrated the great value of such powerful snow fighting machines and their manufacture will become a matter of more importance in the future.

The heaviest snows during the month of February were in Michigan and Wisconsin



Snow Blocked

Another month of awful battles with snow and ice in the United States has come and gone and with the advent of March railroad men hope for a cessation of the conditions that have taxed the capacity of all the lines in the north, east and west. The illustrations herewith produced are from photographs showing some of the familiar experiences encountered in Wisconsin. Locomotives and trains were almost ous wrecks and blockades, many of which were never chronicled in the newspapers. Many trainmen and passengers lost their lives in these terrific storms. Traffic was



Giant Snow Plow Returning from the Rescue of a Buried Train

on the lines running north, northeast and northwest out of Chicago. Not one of them and not a line out of Chicago escaped loss and delay from the terriffic storms. Popular Mechanics described and illustrated the storms of January in the preceding issue, but those of February were even more disastrous, and in fact there has been scarcely a month during the winter of 1904 that has not been marked with intense cold and destructive snows. Railroad men and shippers and passengers will long remember the winter of 1904 as one of the severest known in American history.

EASY ELECTRICAL EXPERIMENTS

A DUPLEX TELEGRAPH INSTRUMENT.

Probably every ingenious boy, who is interested in electricity, has at some time or other, constructed a simple telegraph line, and operated it in the simple manner so well understood by every amateur. The problem of sending more than one message over one wire at the same instant is a very interesting one, and while the amateur will have no great need of instruments capable of doing this, yet it is thought that the construction and operation of the instrument described below will be a source of pleasure and will throw much light upon the more interesting problems of telegraphic work. The apparatus as described is capable of transmitting two messages

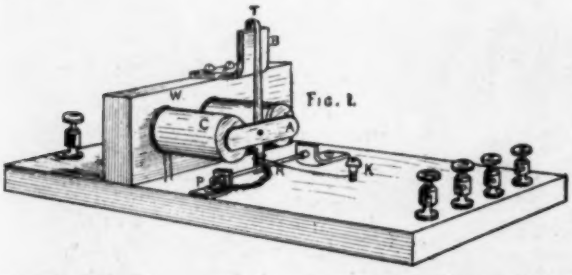


Fig. 1.

simultaneously over the same wire, the messages traveling in opposite directions.

A relay will first be constructed, which differs from the ordinary relay only in the fact that it is wound with two distinct sets of wires, and is used with these two windings opposed to or neutralizing each other. Hence it is called technically a differential relay.

A general view of the instrument is shown in Fig. 1. A baseboard should be made first whose length is 6 inches, of a thickness of ½ inch, and a width of 3 inches. At a distance of 1½ inches from one end an upright strip extending across the base is fastened, the height of this strip being 1¼ inches. It is shown at W in Fig. 1, and is to support two magnet coils, shown at C. These magnet coils are made by taking two small-head carriage bolts, ¼ inch in diameter, and fitting tightly to them 2 circular heads for the spools, the diameter of the heads being ¾ inch, and their thickness ⅛ inch. After wrapping the iron core with a layer of tough paper, the spools are wound full of No. 32 double silk covered magnet wire. These spools are wound, however, in a special manner. Having a quantity of the magnet wire wound upon two separate reels, a strand of wire is taken from each reel and wound simultaneously upon the spool so that the winding consists of two strands lying closely side by side throughout their entire length. After being wound the iron cores are joined together at the back by an iron strap whose width is about ½ inch, and of such a length that the spools when mounted on this iron strap will have a distance of 1⅛ inches between their centers. The small electro magnet thus formed is mounted to the upright strip exactly in its center. Begining with one end of the winding on one spool, this end should be conected to the first of the four binding posts shown at the right. The other end of this coil (ascertained by testing with galvanometer) will be connected to one end of one of the coils on the second spool in such a manner that a current going around the magnets would trace out an imaginary letter S. The farther end of this coil on the second spool is connected to the second of the four binding posts. In a similar manner, the remaining coils are connected up to the last of the four binding posts. This is really no different from the ordinary way of connecting the coils of an electro magnet, except that we have two sets of windings to connect instead of one.

An armature, shown at A, should be cut out of a piece of thin soft iron, and should be riveted to a thin strip of brass 3 inches long, at a distance of ⅜ inch from one end

of the strip. This end of the brass strip is soldered to a round rod shown at R, whose length is 1½ inches, and which serves as a pivot for the support of the armature and its brass rods so that the latter may move very freely back and forth in close proximity to the poles of the magnet. Accordingly this rod is filed to a sharp point at each end and these sharp points fit into sockets bored in the end of small screws which are supported by little brass clips shown at P.

About the magnets and supported by the strip W is a bent piece of 1-16 inch copper shown at B. It should be of such a length that when the armature A is very close to the ends of the magnets, the brass strip at T bears firmly against B on the front side of the latter. The strip T is bent over back of B with just enough play so that the armature A may move freely back and forth in front of C, the end of the brass strip moving through a space of about 1-16 inch. It should make contact with B only when A moves toward C, so a piece of heavy paper should be glued to the back side of B so that T can touch it only on the front side. This tongue closes a local circuit at B in the ordinary manner employed by all telegraph systems. To draw A away from C a very small rubber band may be attached just above R, the other end of which is wound around an adjusting screw K. As current must be led through R, and as the contact of the latter with its pivots is uncertain, a coil of very fine wire should connect R with P as shown.

The manner of operation of this relay is shown in Fig. 2. Of course two relays will be required, one at each end of the line. These are represented at A B and C D. Confining our attention to the former, A and B represent the two coils on our relay and K a special form of key which makes contact with the battery H when pressed down and with the ground wire W when allowed to move upward. L is the line, and R an artificial resistance connected to the outer end of A, and adjusted so as to be equal in value to the resistance of the line. Let us now examine the operation of the relay. If K be pressed downward, a current will flow from the battery H upward into the coils A and B. But if these coils are properly connected the current in coil A will circulate around the magnet in a direction opposite to that in which it circulates in coil B. Since these two coils are equal in length, and are wound together the current will not affect the relay at all. A portion will flow through R to the ground, and another portion will flow through L into coil C at the right and thence to the ground through P. This current will have its full effect in coil C and will affect coil D only by a very slight amount. Moreover, if any current goes through D its effect is added

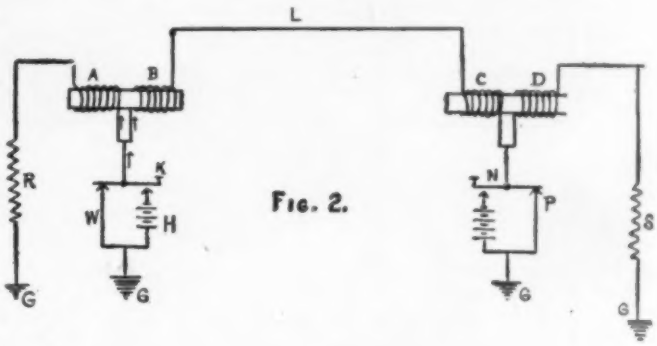


FIG. 2.

to that of C, so that the effect of the line current is to excite the relay at the right. The right hand relay, therefore, responds to signals from K alone, and the left hand relay in the same manner, responds to signals from N alone. What would happen if the two keys be pressed simultaneously? If this be the case and the batteries be equal in strength, no current will flow in the line, but current will flow through A and D, exciting both relays. But the relay at the left will be excited only as long as N is held down, and the relay at the right will remain excited only while K is held down. Thus each relay is excited only when the key at the farther end of the line is pressed and is not affected by the key at its own end of the line. If this is the case, messages may be sent by K to the right, while messages are at the same time being sent by N toward the left. An extension of these principles enables four messages to be transmitted over a given wire at the same instant.

German locomotive builders are now building from American models.

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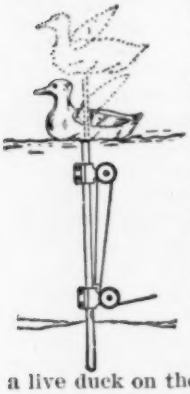
DECOY DUCK THAT FLIES.

A decoy duck that flops its wings and goes through other life-like motions calculated to deceive the real bird, is a recent invention. Tests have shown its great superiority over the old fashioned decoy.



The mechanical duck is fastened to the top of an adjustable pole, the lower end of which is stuck in the bottom of the pond or stream. The duck is set so as to rest on the surface of the water. From the duck a strong cord reaches along the bottom of the pond to the bank or blind. When the cord is pulled the duck rises in the air, works its wings and neck and sends forth a call which cannot be distinguished from that of a live duck on the wing.

YOU CAN IF YOU WILL.

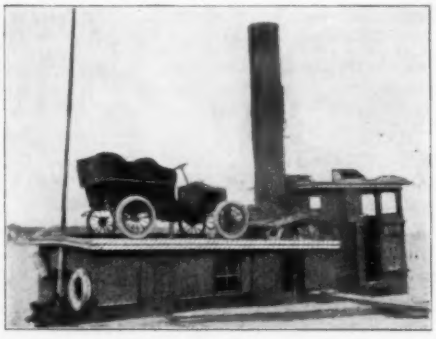
Few people realize what they can accomplish if only they determine to do a thing and stick to that decision. The persevering boy or man who never gives up will in the end show results which others more brilliant do not because they falter. John Rockefeller, jr., in an address to the young men of his bible class said:

"If you are in earnest to the innermost fibre of your body, there is no power on earth that can hold you back from the object you strive to obtain."

And he is right.

CARRIES AN AUTO ON HIS BOAT.

A New York contractor for marine construction has a tug in which he visits and inspects the work. He is also a great lover of automobiling, and carries his machine



fastened to the top of the cabin of his boat. When he has a few hours' leisure time, he lands, runs the auto ashore, takes a spin and reloads it on the boat.

ENGLISH AUTOMOBILE LIGHT.

The regulations regarding numbers and signal lights on automobiles in Great Britain are very exacting. The license number

must be plainly displayed at each end of the machine both day and night. For running at night the signal illustrated is used, displaying the number and a red light at the rear and number and white light at the front.

A Michigan professor claims to have succeeded in imparting to rain water curative powers for cancer. He energizes the water from a tube of radium.

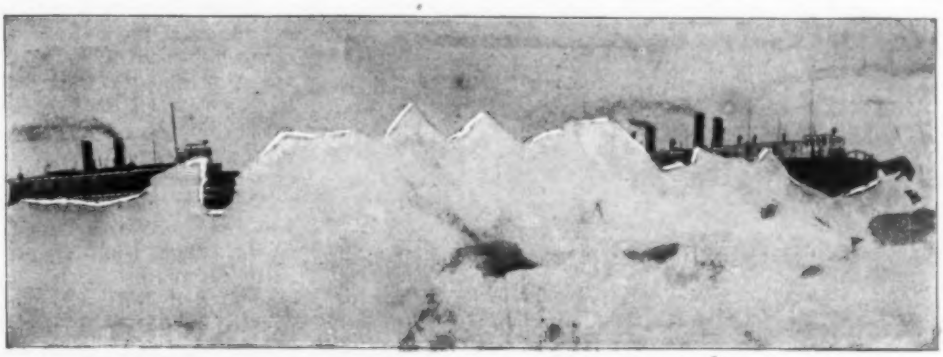
Russia Copies American Ice Crushers

Powerful Ferries That Crush Their Way Through the Frozen Fields 30 Feet Thick in the Straits of Mackinac

Russia has adopted an American type of ice crusher for use in the Baltic Sea and in the war with Japan has found them of most valuable service in keeping the sea open for traffic in the hurried shipment of supplies. The ice breakers had their birth in the Straits of Mackinac, where the channel is frozen over four months in the year. It is these ice crushers that permit the regular operation of the railroad ferries across the water between Mackinac City and St. Ignace. When winter rages hardest, when other vessels are frozen in port, no matter how thick the ice or how cold the weather, these ferries make their trips as regularly as the days. They plow their way through the great field of ice, turning a furrow often as high as the ship. Crashing, wedging, tearing with seemingly irresistible force the ferry pauses not on its journey until the destined port is reached.

Car Ferry St. Marie Pushing Through the Ice in the Straits of Mackinac

The ice crushers built for the Mackinac service were the first of their type ever constructed. One of the ferries yet in service is the St. Ignace, the first crusher in the world to be fitted with both bow and



Car Ferries St. Ignace—St. Marie, Crossing the Straits of Mackinac

stern propellers. The bow screw dislodges the ice by the displacement of water at that end. The St. Ignace was built in 1889. She is 235 feet long overall, 52 feet beam and 25 feet deep. She has a tonnage of 1,199. Her engines are fore and aft compound with cylinders 28 inches and 52 inches diameter, by a stroke of 40 inches. She has three double-ended Scotch boilers, 11.6 feet by 18 feet, allowed 120 pounds pressure. The size of the forward wheel is 10 feet. She carries ten freight cars and her speed is 15 miles an hour.

The St. Marie is of the same general design, but is a newer and larger ship and is probably the most powerful ice crusher in the new world. The St. Marie was built in 1893. She is 305 feet overall, 52 feet beam and 25 feet deep. Her tonnage is 1,357. She has a hull of wood, sheathed with steel. Her after engines are compound, with cylinders 28 and 52 inches in diameter, by a stroke of 40 inches. Her forward wheel is 10.6 feet and her after wheel 12 feet, making 100 revolutions. She has four double-ended Scotch boilers with cylinders 11 feet 6 inches by 18 feet. The St. Marie carries 18 freight cars and her speed is 16 miles per hour.

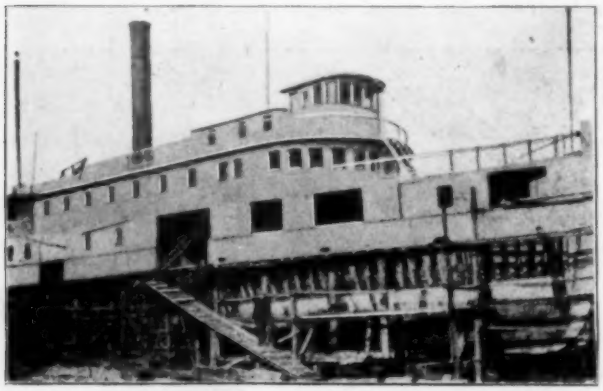
The framing of the vessels is exceedingly massive in order to withstand the great shock and pressure in cutting through the mass of ice which often extends from 25 to 30 feet below the surface. The frames are 24 inches wide and 12 inches thick. There are 15 keelsons, none of which is smaller than 14 inches square. At the turn of the bilge there are two extra keelsons 24 inches square. The extra frames at this point make an almost solid shell. The planking is 6 inches thick and the hull is nearly 3 feet thick on the bottom. The sides at the water line are protected by steel plates 2 inches thick.

SAWED A STEAMER LENGTHWISE.

The Newest Achievement in Naval Architecture

Houses have been raised and an extra story inserted, why not raise a boat in the same manner? That was the question which the owner of the sidewheel steamer Ulster asked the Erie Basin Dry Dock Co., and the builders saw no good reason for not doing something which had never before been attempted or thought of. Time and again had large ships been cut in two and lengthened, but there was no experience to guide the new undertaking.

The vessel was built of wood which somewhat simplified the task, as this made it possible to saw her in two, which was done just above the guard. When this had been done seventy-three five-ton screw jacks were distributed round her sides and inside under the decks. The upper part of the ship was lifted away from the lower part in this fashion: Workmen were placed at every third screw; when the signal to start was given, the men, moving and working as nearly automatically as possible, passed from screw to screw, giving each one, as they passed, a quarter of a turn. This lifted the boat up about one-fifth of an inch; this was kept up until the limit to which the screw could be raised was reached, when there was a space of about six or eight inches between the ship and the cribbings. By packing up the jacks and making several more lifts the necessary space of two feet was put between the two parts of the vessel. The timbers, stem and sternpost, were then scarfed and the open space planked up. The Ulster is 205 ft. long, 30 ft. beam, and of 690 gross tons.



Sawing a Steamer Lengthwise

MAKING HUMAN NOSES OF WAX.

Ugly Forms Rendered Beautiful by Mechanical Means

If your nose is out of shape, if it is too large on one side, or humpy in the middle, you can have it equalized and brought into a condition of grace and symmetry. And all this without the use of the knife or drawing one drop of blood.

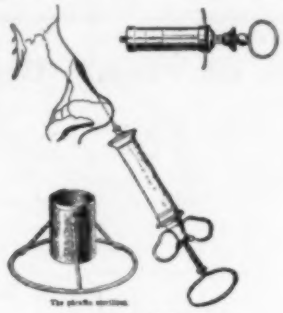
The mechanical means by which this transformation is accomplished are few and simple, although a considerable amount of

skill and experience are necessary, or the operator may make you hideous in appearance.

A special syringe and some paraffin wax constitute the equipment.

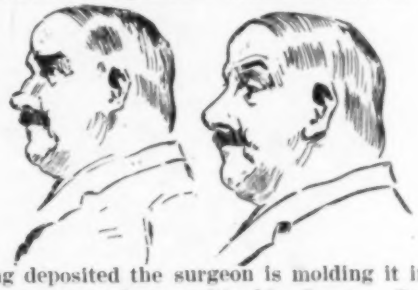
As described in the Journal of the American Medical Association, the process includes four stages: 1, preparation; 2, anesthetic; 3, introduction of the paraffin; and 4, after treatment. The preparation is highly important to the success of the effort, consisting of a thorough scrubbing of

the nose with antiseptics 24 hours previous. The anesthetic is usually a local one, of either cocaine or freezing with ethyl



Syringe and Method

chlorid. When all is ready the paraffin, which has been reduced to a fluid by boiling, is drawn into the syringe. The skin of the nose is picked up in a fold and the needle point of the syringe inserted under the skin. The point at which the injection is made depends upon the location of the fault to be corrected. The needle is inserted to the farthest point to be filled and gradually withdrawn while the wax is being injected. As the wax rapidly cools and hardens, a special syringe is required, which pushes the paraffin out by means of a screw arrangement. While the wax is be-



ing deposited the surgeon is molding it into permanent shape with his finger. Great care must be exercised not to insert any more wax than is actually required, and if not enough has been used a second operation is done to complete the work. There is considerable inflammation and swelling for perhaps 12 hours after, but no further treatment is usually necessary.

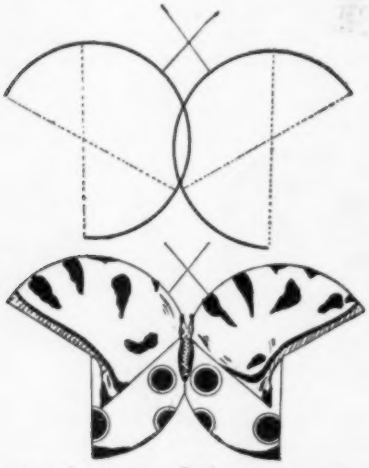
In the hands of a skillful surgeon the operation is a comparatively safe one, and the results are often so remarkable, and the whole appearance of the face so improved and changed, that the patient is not recognized even by old-time friends. The illustrations show results of actual cases, showing the faces "before and after taking."

MECHANICS FOR YOUNG AMERICA

Kites of Many Kinds and How to Make them Jug Fishing

Get your kites ready, boys, for March is here. Don't waste your time on the old style kites your father and your grandfather used to fly; surprise your playmates with a kite of new design, one that will make all the boys, and even the grown folks, look on in wonderment. Kites can be made of nearly any shape. Just bend the sticks right and paste on the paper and then paint the paper with any kind of caricature you desire.

One of the prettiest of all is the butterfly kite. To make this get two thin kite sticks of equal length. Bend each in an arc, tying one end of a strong string to one

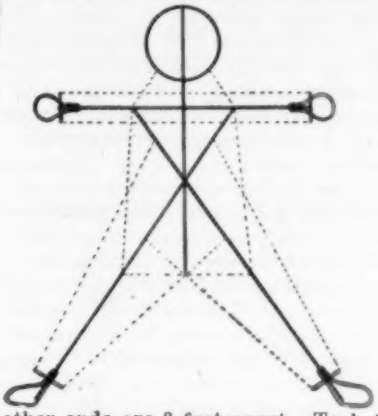


end of each stick and the other end of the string to a point about three inches from the other end of the stick. This leaves one end of each stick free, hooking over the hemisphere described by the thread and the stick. Now tie another thread to each of these free ends and tie the other end of the thread to a point near the other end of the stick, corresponding with the distance from the end at which the first strings were tied on the opposite side. This done, you should have two arched frames, each an exact counterpart of the other in size, curvature and weight. Now fasten the two frames together so that the arcs will overlap each other as shown in the sketch. Bind the intersecting points securely with thread. To make the butterfly's head, secure two heavy broom straws or two short wires, and attach them to the top part of the wing frames near where the sticks intersect, so that the straws or wires will cross. These form the antennae, or the "smellers." Then select the color of paper you want, yellow, brown, blue, white or any other color; lay it on a flat surface and place the frame on top of it, holding the frame down securely with a weight. Then with a pair of scissors cut the paper around the frame, leaving about a half-inch margin for pasting. Cut slits in the paper about two inches apart around the curves and at all angles to keep the paper from wrinkling when it is pasted. Distribute the paste with a small brush and make the overlaps a little more than ¼-inch wide and press them together with a soft cloth. When the kite is dry decorate it with paint or strips of colored paper in any design you may fancy. The best effects are produced by pasting pieces of colored paper on top of the other paper. Black paper decorations show up to fine advantage when the kite is in flight. Attach the "belly-band" to the curved sticks by punching a hole in the paper in the same manner as it is attached to the common hexagonal or coffin-shaped kite. With a tail, your kite is ready to fly.

Another interesting design is the boy kite. With light colored coat and vest and gay striped trousers, the kite standing high in the air always attracts attention and affords splendid sport for the American youth in springtime.

In making a boy kite it should be remembered that the larger the boy is the better he will fly. To construct the frame, two straight sticks, say 3½ feet long, should serve for the legs and body; another straight stick forms the spine and should be about 2 feet 4 inches long. For the arms, get a fourth straight stick about 3 feet 3 inches long. Make the frame for the head by bending a light tough stick in a circle about 7 inches in diameter. Bind

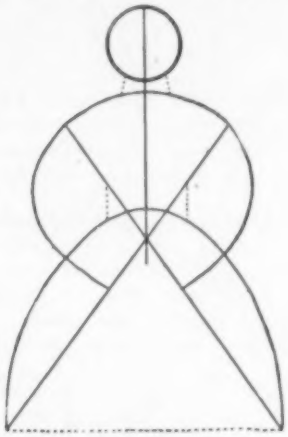
it tightly with a strong thread and through its center run the spine. Then tack on the arm stick three inches under the circle so that the spinal column crosses the arm stick exactly in the center. Wrap tightly with strong thread and tack on the two sticks that are to serve for the legs and body. The leg sticks should be fastened to the arm stick about 6 inches on either side of the spinal column, and crossed so that



the other ends are 3 feet apart. Tack them and the arm stick together at the point where they intersect. Small hoops and cross stick of the same material as the head frame should be fastened to both extremities of the arm stick and the lower ends of the leg stick for the hands and feet. See that both hand frames are exactly alike and exercise equal caution regarding the foot frames; also see that the arm stick is at exact right angles with the spine stick and that the kite joints are all firmly tied and the kite evenly balanced; otherwise it may be lopsided. Fasten on the strings of the frame, beginning at the neck at equal distances from the spine and, as indicated by the dotted lines in Fig. 2. Extend a string slantingly from the arm-stick to the head on both sides of the spinal column, and run all the other strings as shown in the cut, being careful that both sides of the frame correspond in measurements.

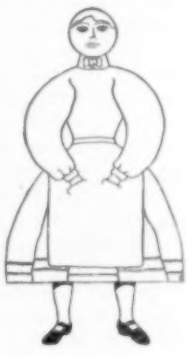
To cover the kite, select different colors of paper to suit your taste, and after pasting them together, lay the paper on the floor and placing the frame on it, cut out the pattern. Leave an edge of ½ inch all around and make a slit in this edge every six inches and at each angle; make the slits two inches apart around the head. After the kite is pasted and dry, paint the buttons, hair, eyes, hands, feet, etc., as you desire. See Fig. 3. Arrange the "belly band" and tail band and attach the kite string in the same manner as in the ordinary coffin-shaped kite.

The "lady kite" is made on the same principle as the boy kite. The frame may be made exactly as the boy kite and then "dressed" with tissue paper to represent a girl, or it may be made as in Fig. 4. Remember the dotted lines represent the



strings or thread, and the other lines indicate the kite sticks. Be careful with your measurements so that each side of the kite corresponds exactly and is well balanced. Also see that every point where the sticks intersect is firmly tacked and bound.

To cover the kite, first paste together pieces of tissue paper of different color to suit your taste. The paste should be made of flour and water and boiled. Make the seams or overlaps not quite 1-3 of an inch wide. Lay the paper on the floor, using weights to hold it down, and place the frame of the kite upon it. Then cut out the paper around the frame, leaving an edge of ½ inch. Don't forget to make a slit in the edge every 6 or 7 inches and at each angle. Around the head the slits are two inches apart, as in the case of the boy kite. After the kite is dry, paint the paper as your fancy dictates.

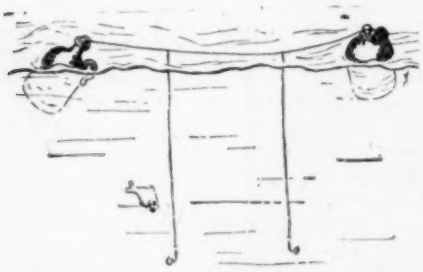


To make the breast band, punch holes through the paper, one upon each side of the leg sticks, just above the bottom, and one upon each side of the arm sticks at the shoulder. Run one end of the string through the hole at the bottom of the left limb and tie it to the leg stick; tie the other end at the right shoulder. Fasten one end of another string of the same length at the bottom of the right leg; pass the string up across the first band and tie the other end at the left shoulder. Attach the kite string to the breast band at the point where the two strings intersect. Tie the knot so that you can slide the kite string up or down until it is properly adjusted. The tail band is made by tying a string to the leg sticks at the bottom of the breast band. Let the string hang slack below the skirt and attach the tail to the center. The same general rules apply in attaching the string and tail to the boy kite.

You can make the lady look as if dancing and kicking in the clouds by making the feet of stiff pasteboard and allowing them to hang loose from the line which forms the bottom of the skirt. The feet will move and sway with each motion of the kite.

FISHING TIME COMING SOON.

Fishing time will soon be here and this year you want to have some new and effect-



ive methods of catching fish. Popular Mechanics will describe different processes in a later issue, but will tell of the "jug line" now because it is especially adapted for early fishing. Fasten two jugs to a strong line about 30 feet long. Be sure that each jug is securely corked. To the long line attach a couple or more of short fish lines equipped with proper sinkers and baited hooks. This done, place the outfit in the water and watch it, ready to follow with a row boat, or let it float down stream attached to a line held in the hand. When one of the jugs sinks or commences to bobble, you can row out to the line and pull in the fish. On the Mississippi river dozens of jugs are often thus tied together and the fisherman follows them in a row boat until he has a good boat load.

STEAM LOCOMOTIVES TO BURN ELECTRICITY.

Startling Innovation Proposed on Swiss Railways

The Swiss proposed to burn electricity under their locomotive boilers instead of coal. Switzerland does not own a pound of coal of her own; it is all imported at great expense. But she does possess the most valuable water powers in the world. The boundless snows of her lofty mountains furnish a never ending source of energy. The water falls are rapidly being harnessed and made to turn generators whence come enormous electric powers for driving the wheels of her factories and lighting her cities.

Recently some daring mind conceived the idea of placing a great white mass of electric fire under the boilers of the steam locomotives. The result will be tremendous heat without any smell, smoke or cinders. The plan is not feasible except where electric power costs practically nothing to produce. This Switzerland is doing with her water power plants.

A small wire stretched overhead in the middle of the track will carry the current which will be conducted to the locomotive by a trolley, on the principle of our own trolley cars. The prime reason which suggests this bold conception was not only to save the cost of coal now used, but also to avoid the expenditure of the millions of dollars necessary to build electric locomotives and throw out the steam engines. The changes required will be few, and the present force of engineers will need but little instruction. The "fireman" will have only to pull a lever and his work is done for the trip.

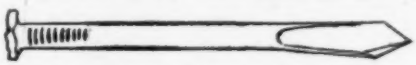
POSTAL CAMERA CLUBS THE FAD.

Postal camera clubs are becoming a fad in this country, as they have already been for several years in England and Europe. The members are made up of amateur photographers residing in different parts of the country who forward to each other interesting pictures they have taken. The prints are made from the negatives directly onto postal cards, and the collection thus secured in a few months gives glimpses of scenes from widely separated localities.

SHOP NOTES

HOME-MADE BIT.

You need never want for a small bit with which to bore a hole. All you have to do is to take a wire nail and hammer the



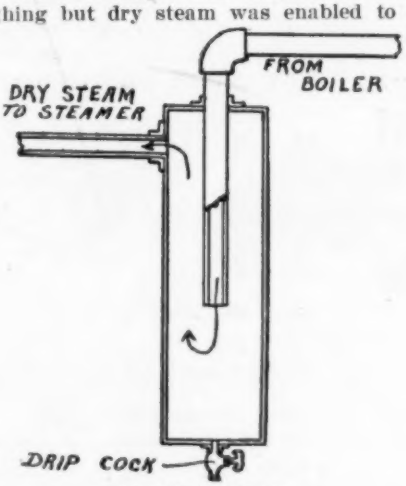
point flat, after which point and sharpen it as shown in the cut. The head is squared by a few blows with a hammer to fit the stock.

DRY STEAM FOR WHEAT STEAMER.

A writer in the American Miller tells how he made a trap for supply dry steam to his wheat steamer. He says:

Before using this wrinkle I had hard work to keep my steamer doing even work, as there was too much condensation before the steam reached the steamer. We had a standard make of steamer, but the great distance from the boiler prevented it from doing successful work.

After installing the trap I found it to be a wonderful help. The steamer receiving nothing but dry steam was enabled to do



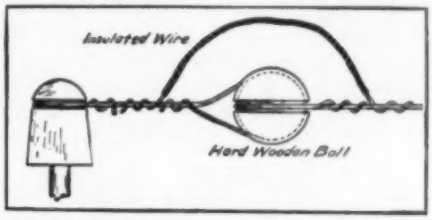
Trap for Dry Steam

excellent work. Any one adopting this plan will be pleased with results. The trap can be made by using a piece of pipe 3 or 4 inches in diameter and about 14 inches long. Cut threads on each end and screw caps on, making a drum. Then proceed to pipe it as per diagram.

ENGLISH ANTI-HUM DEVICE.

The method here described of preventing the vibration in telephone wires from being communicated to a building to which they are attached is said to be in quite extensive use in England. We quote the description from the London Electrical Engineer:

"In the fixing of wires to buildings trouble is sometimes experienced through the humming noise, and several more or less effective methods of overcoming the difficulty exist. One plan is to bind in the line wires



with strips of lead about ½-inch wide, and twist the lead round the wires for a distance of about 12 inches from the insulator. A better and more excellent method is to break the wires about 18 inches from the insulators, as shown in the figure, and insert hard wooden balls doubly grooved for making off and terminating the wires, the continuity of the wires being made by bridging over the wooden balls with a piece of insulated wire."

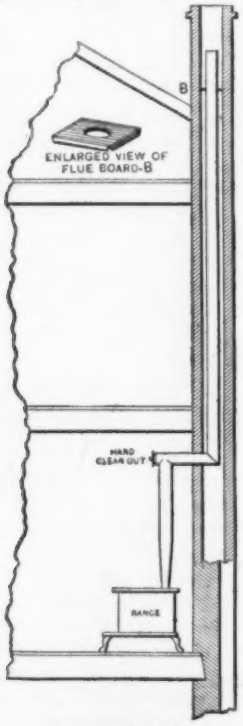
RADICAL CHANGE IN BLUE PRINTS.

A radical change is being made by the larger machine builders in their blue printing. Instead of white lines on blue paper they are now printing blue lines on white paper. The advantages are too obvious to require comment. This is accomplished at small expense by means of what is known as negative paper, which is printed from the tracing, the result being a white lined drawing on a deep, brownish-gray background. This background is opaque, while the white lines are very transparent. All subsequent printing is from the negative paper, the tracing being discarded for the purpose. This new blue print is of especial value as a substitute for original drawings, which may be preserved in their freshness.

Excellent prints may be obtained as a substitute for the ordinary blue prints to send to prospective customers. For shop use, however, the old blue print is considered the better, because the blue background soils less easily, and it is more easily read after being shop handled.

A CHIMNEY REMEDY.

Here is a method which its author, writing in the Metal Worker, guarantees to cure an obstinate chimney which refuses to draw. He accomplishes this by means of an extended smoke pipe and a flue board. Where the smoke pipe enters the flue, it is the intention that it be continued on up the flue to near the top of the chimney, where it should connect with a flue board made of heavy, galvanized iron, with a hole in it for the smoke pipe to pass through. This flue board should fit horizontally across the flue and should be made of heavy sheet iron, with an edge or lap of one inch turned up on



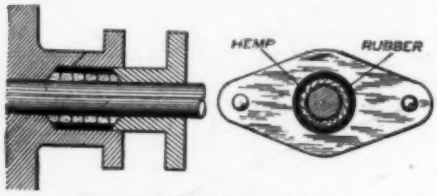
Improved Draft

all four sides, so that it can be nailed into the mortar to hold it in position. It should be the exact size of the flue, and after the pipe is connected with it, mortar should be put on the top of it to make the connection with the smoke pipe and to render the walls of the flue air tight, as well as to increase its durability by preventing rust. If it is necessary, at any other time, that another stove pipe shall connect into the same chimney flue, either a larger pipe can be used and the additional pipe connected with it by means of a tee joint; or, if the original flue is large enough, a second sheet iron pipe can be run up alongside of the other. The advantages of having a horizontal sheet iron flue board in a chimney, near the top, are that the chimney is then air tight, soon gets hot and stays hot, and therefore the draft is much more powerful. Again, it is cheap and simple, and any apprentice boy can put it up. By providing a hand clean-out to the elbow at the top of the pipe from the stove, where it turns into the chimney, as shown, the pipe can be kept clear and a full draft realized.

A SIMPLE HOME-MADE PACKING.

A description of a home-made packing which is especially adapted to piston rods that are worn and scored may be of interest to engineers. Almost every engineer has the material at hand with which to make it because all that is required is a piece of rubber hose and some hemp. The hose should be as heavy as can be obtained, says the Engineer.

To apply the packing cut off a length of hose equal to the depth of the stuffingbox, leaving about ¾ inch for the gland to enter



Home-Made Rod Packing

the box and also leave room for the rubber to expand when it gets warm. When the hemp is well soaked with cylinder oil, either braid or twist the hemp to fit the space between the rod and the rubber cushion and drive it in with a piece of soft wood until solid. Then screw up the gland tight enough to render the packing firm. When the packing gets warm begin to slacken the gland bolts so that the rod will not heat.

When starting the engine in the morning it will leak some but as soon as it gets warm the leak will stop, and when properly adjusted this packing will run for three or

four months. When renewing the packing just loosen the gland and add some more hemp.

THE VALUE OF MANUAL TRAINING.

Comparison of the Educated Youth with the Uneducated Reduced to Dollars and Cents

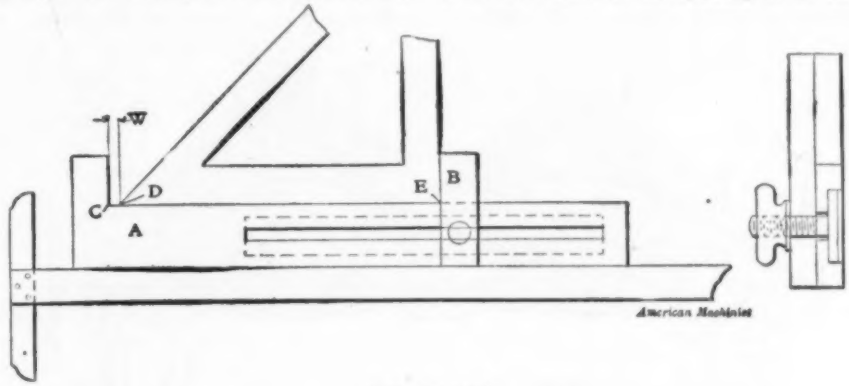
The boy who spends three years at a trade school overtakes and passes the one who goes directly into the shop. The following is abstracted from the Manufacturer, by the Electrical Review:

This is a more detailed study of the comparative value of manual training, as obtained in trade schools, and shop training, than was given by the author, Mr. James Mapes Dodge, in his recent address before the American Society of Mechanical Engineers. He starts with boys sixteen years of age, each of whom can obtain work at $3 per week. One set goes into the shop; the other takes a three-year course at a trade school. The potential or invested value of each—that is, the value on which his weekly wages amount to five per cent—is $3,000. The shop-trained apprentice receives an increase in wages of sixty cents per week for each six months of service, until he reaches the age of nineteen and one-half years, when his wages are $7.40 per week. They are raised to $9 a week at the age of twenty, and to $13.20 per week at the age of twenty-one and one-half, finally reaching $15 per week at the age of twenty-four. The graduate of the trade school, leaving the school at nineteen, can command a wage of $12 per week. He is then two years ahead of the shop-trained apprentice, or his invested value is $12,000, which is more than $5,000 greater than that of the shop-trained boy of the same age. His increase from this point is less rapid, but he reaches a wage of $15 per week—the maximum reached by the shop-trained—at twenty and one-half years, and is then three and one-half years ahead of the latter. His wages at the age of twenty-five are $22 per week, and his invested value is $22,000, an increase of $19,000 in nine years; and from this point he continues to rise. His average yearly increase in value at the age of twenty-five has been $2,100 per year, as compared with $1,300 for the shop-trained. The author says that of all the trade school boys he has employed, only one per cent have failed completely. The rest are still with his company and have advanced, or have left for better situations. Of the shop-trained boys, only five per cent rise above $15 per week. Thirty-five per cent remain in the employ of the company indefinitely, without rising above this point; twenty per cent leave of their own accord, and forty per cent are dropped gradually.

A GOOD SECTION LINER.

A home made section liner which is practical, reliable and quick acting is described in the American Machinist. It is made of transparent celluloid, 1/8 inch thick, though hard rubber will answer. A 45-degree triangle is used and worked as follows:

First set on piece A the movable slide B to the length of the base of the triangle plus the width of the spacing W of the section lines needed, and clamp it. Draw the first line when the point C is in contact with point D, then move the triangle to point E and piece A to point D. Two lines can be drawn now by shifting triangle. Repeat until the sectioning is completed.



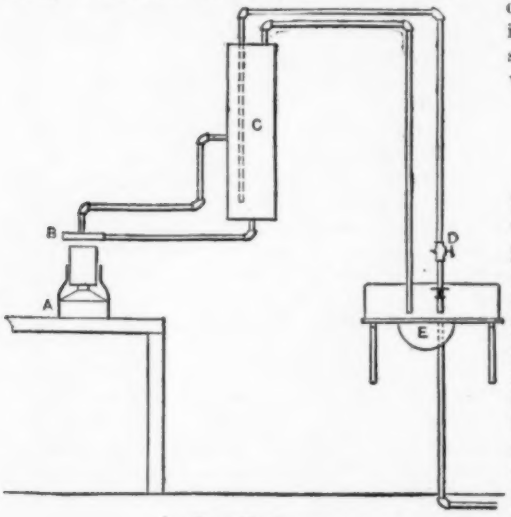
A Section Liner

Dimensions are not given, as this tool

should be made to fill the requirements of each individual. The construction is self-evident from the sketch. The piece A slides along the T-square as shown, and all movements of the liner can be easily made with one hand. A little practice will produce very rapid work.

HOME-MADE SHOP WATER HEATER.

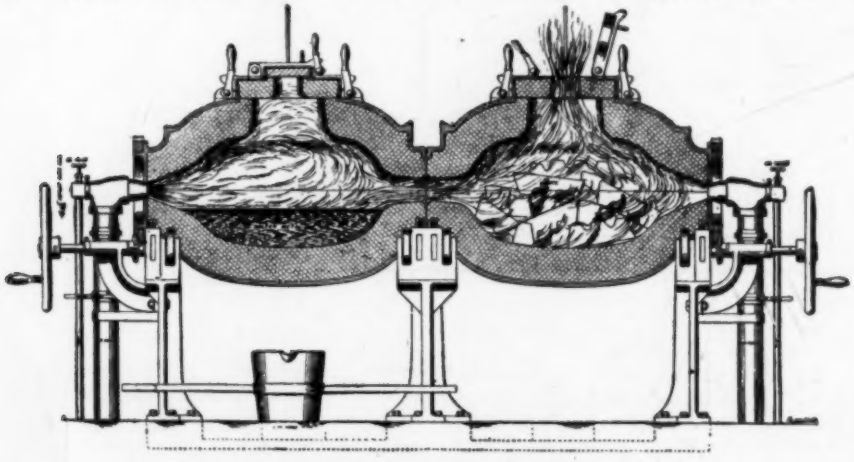
Any shop furnished with a gasoline furnace, or furnace for heating soldering coppers, can easily have plenty of hot water for washing purposes. The Metal Worker tells how one of its readers made the device: "I have made of heavy sheet metal a water heater 1 inch in height and 7 inches in diameter. From the top and sides of this heater one half-inch pipes lead to a hot water storage tank made of No. 24 galvanized iron, which is 8 inches in diameter and 30 inches high. This is securely supported to one of the walls of my shop, convenient to a wash bowl, and is connected, as shown, with the water heater by half-inch pipes. I have taken a cold water supply pipe to this wash bowl, and led it to the storage tank and connected it to a tube that runs down inside nearly to the bottom. From the top of the tank I have brought over to the wash-stand another pipe which is open at the end, and I control the water supply by using a stop cock on the cold water pipe."



Shop Heater

NEW ROTARY MELTING FURNACE.

A new style of rotary melting furnace has been put on the market, which uses the waste gases of combustion. The furnace is in two sections, and will melt two different metals at the same time, or the same metal in both chambers. Usually one chamber is filled with fresh metal while the other is in a molten state. Four sizes are made, ranging from 350 to 3,500 pounds for each chamber. The Foundry says: One of the chambers is always in the act of melting, the other receiving the spent gases which give up their heat into the fresh charge of metal in this latter chamber. As soon as one melt is poured and the chamber recharged the fire is practically continuous. It is quite reasonable that it should result in saving fuel and time and protect the metal. While the operation as a whole is rapid it will be seen that the metal is heated gradually, and that the fuel never enters a cold chamber.



SECTION SHOWING FURNACE IN ACTION.

SIMPLE OILING SYSTEM.

An oiling system which was home made at a cost of only $20 has been in successful use for several years at the power house of the electric road in Portland, Me. It was devised to avoid the use of auxiliary pumps for lifting the oil as required by gravity or compressed air apparatus. In the Street Railway Review, the manager says:

"We took a piece of heavy iron pipe about 1½ ft. in diameter and about 7 ft. long. We capped it at both ends and stood it on end for our oil pressure tank. Then to get the pressure, we merely connected the bottom of this oil pressure tank to the city water main."

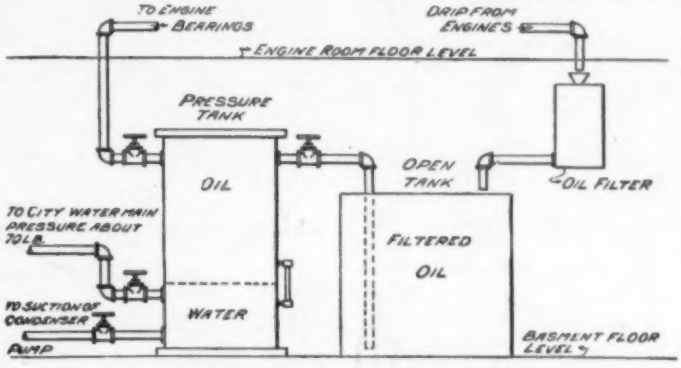


DIAGRAM OF OILING SYSTEM.

The general layout of the system is indicated in the diagram. The oil in the pressure tank floats on a stratum of water, the water coming from the main at about 70 lb. pressure. The water forces the oil up through the feed pipe leading from the top of the tank to the engine room above and to the bearings of the several engine units. The oil drips from the engines are collected in drip pans and flow by gravity to the oil filter, from which the filtered oil flows by gravity into the open tank for storing the filtered oil. From the bottom of this filtered oil tank, a connection leads to the top of the pressure tank previously mentioned. When the water in the pressure tank has risen sufficiently to force nearly all the oil therefrom, the connection to the water main is closed, and a valve is opened giving connection to the suction of one of the condenser pumps, that pump being used when happens to be working at the time. This action draws the water from the bottom of the pressure tank and at the same time draws filtered oil into the top of the pressure tank from the filtred oil storage tank.

The only attention required by the apparatus is that the level of the water in the pressure tank be watched to prevent the supply of oil from becoming exhausted and the water from rising into the oil piping system. This is not a serious task. A glass gage shows the level of water at all times. A compressed air system to do the same work would have cost $1,500. If the city water pressure should ever fail connection can be made to the boiler feed supply.

REVERSING SINGLE VALVE ENGINE.

To reverse a single valve engine put the crank on either center and scribe a line on the valve-stem next to the stuffing box; loosen the eccentric and turn it on the shaft until the mark in the valve stem is again even with the face of the stuffing box; tighten the eccentric and the engine will run in the opposite direction to what it formerly had. Care should be taken not to move the stuffing box during the operation and to see that the crank is still on the same dead center when tightening the eccentric that it was at the outset.

A HEAT PROOF PUTTY.

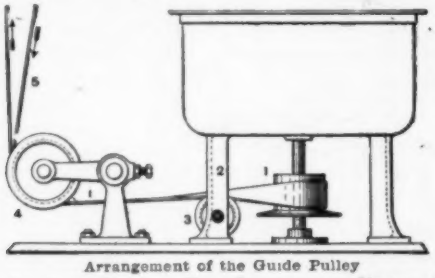
Mixing a handful of burnt lime with 120 grams of linseed oil, boiling down to the usual consistency of putty and allowing the plastic mass to spread out in a thin layer to dry in a place where it is not reached by the sun's rays, yields eventually a very hard putty. When required for use it is made plastic by holding over the funnel of a lamp; on cooling it regains its previous hardness.

FIVE-YEAR SUBSCRIPTIONS.

In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

AN INGENIOUS GUIDE PULLEY.

After a number of machinists had endeavored to prevent a belt from running on the flange of a small pulley on an extractor used in a laundry for wringing clothes, and which on two occasions had broken the flange as well as destroying the belts, an idea struck me that by placing a guide pulley underneath the belt and a little higher than the flange it would have a tendency to alleviate trouble. Thus writes a correspondent to the Engineer.



Arrangement of the Guide Pulley

So I made a pulley from an ordinary 3-inch pipe socket. I first plugged it with wood, then drilled in the center for a ½-inch pipe and in the end of the plug I drilled a hole, and also through the pipe, for an oil hole. Then, after finding a suitable bolt I drilled and tapped one of the legs of the machine and mounted the pulley on the bolt. It has answered the purpose very well and is running satisfactorily.

A BLUEPRINT PAPER FOR BLUE LINES ON A WHITE PAPER.

The following process, credited to Captain Abney, yields a photographic paper giving blue lines on a white ground:

Common salt	3 ounces.
Ferric chloride	8 ounces.
Tartaric acid	3¼ ounces.
Acacia	25 ounces.
Water	100 ounces.

Dissolve the acacia in half the water, and dissolve the other ingredients in the other half; then mix.

The liquid is applied with a brush to strongly-sized and well-rolled paper in a subdued light. The coating should be as even as possible. The paper should be dried rapidly to prevent the solution sinking into its pores. When dry, the paper is ready for exposure.

In sunlight, one or two minutes is generally sufficient to give an image while in a dull light much as an hour is necessary.

To develop the print, it is floated immediately after leaving the printing frame upon a saturated solution of potassium ferrocyanide. None of the developing solution should be allowed to reach the back. The development is usually complete in less than a minute. The paper may be lifted off the solution when the face is wetted, the development proceeding with that which adheres to the print. A blue coloration of the background shows insufficient exposure, and pale-blue over-exposure.

When the development is complete, the print is floated on clean water, and after two or three minutes is placed in a bath, made as follows:

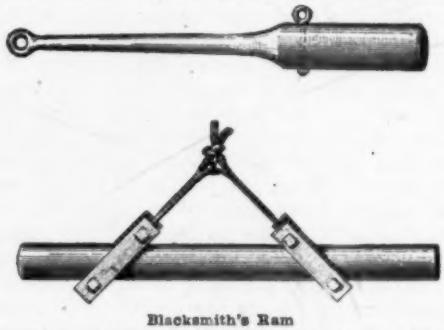
Sulphuric acid	3 ounces.
Hydrochloric acid	8 ounces.
Water	100 ounces.

In about ten minutes the acid will have removed all iron salts not turned into the blue compound. It is next thoroughly washed and dried. Blue spots may be removed by a 4 per cent solution of caustic potash.

The back of the tracing must be placed in contact with the sensitive surface.

BLACKSMITH'S RAM.

Every blacksmith shop should have three rams, according to the Blacksmith and Wheelwright. The rams are used for butt welding. One should be of soft steel, three inches in diameter; another forged from a piece of 4-inch cold rolled shafting; and a third from five or six-inch shafting for heavy work. Do not depend on hanging the



Blacksmith's Ram

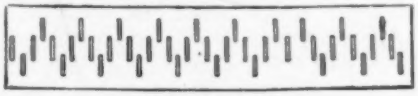
ram by a rope passed around it. Drill a hole clear through and use an eye-bolt, as shown in the first cut, or use two clamps, as in the second cut. Never use screw-eyes, as they are sure to break off at the critical moment.

If the end of the ram is to be hardened for use on cold iron, the layer of steel

should be a little thicker—say ¼-inch—and it may be hardened by means of a hose attached to a hydrant or tank of water so as to give a good head to the steam. The trick of hardening large pieces of metal is to keep the cold water in contact with the metal to be hardened. When a large piece of steel is heated and plunged into water, steam is generated which very effectually keeps the cold water away from the hot metal, therefore the cooling of the steel is so slow that a sufficient degree of hardness cannot be obtained. With the hose, a powerful stream of water is at all times forced against the steel, and the steam is forced away as fast as generated, the cold water constantly reaching the steel and carrying away the maximum quantity of heat possible. When a hose is not available, procure a half-a-dozen pails, fill them with water and stand them handy. Place the ram hot end uppermost, and let two men man the pails of water and keep a large solid stream constantly flowing upon the end of the ram, which can be made quite hard in this manner.

LOCOMOTIVE SPARK PREVENTER.

The Germans are fostering their forests, and in pursuance of this policy are taking great precautions against forest fires. Their locomotives all carry spark arresters which, while retaining the sparks have caused some trouble in choking up the escape. A recent



Spark Arrester

invention consists of three grates, set one above another in a square iron or steel frame of proper size to fit into the smoke chamber of the locomotive. Each bar is two inches wide by one-tenth of an inch thick. The middle tier contains twice as many bars as the top and bottom tier. No spark or ember larger than 16-100 of an inch can escape and these are so small they are self-extinguishable in going a few feet. The bars readily expand and contract.

ALUMINUM CONDUCTORS FOR ELECTRIC LINES.

Alton D. Adams says that the inferiority of aluminum as an electrical conductor in terms of sectional area is more than offset by its superiority over copper in terms of weight. For equal resistances the weight of aluminum is only one-half as great as that of copper wire of the same length. When the price per pound of aluminum is less than twice the price of copper the former, he says, is the cheaper for a transmission line of any required length and electrical resistance. The principal demerits of aluminum are its liability to oxidation when exposed to the fumes of chemical works and its liability to corrosion in moist air when it is impure, especially when it is alloyed with sodium. It is also hard to secure soldered joints.

THE VERANT—NEW INSTRUMENT FOR PHOTOGRAPHERS.

The Verant is a new instrument for photographers by which the apparently ludicrous perspective caused by short focus is overcome. It was recently exhibited and

The Verant

exploited before the Royal Photographic Society by Dr. Moritz von Rohr, who said:

"Summing up, we come to the following conclusions: Supposing we have a Verant lens of the focal length of the camera objective, a normal eye will obtain, through the Verant, as far as perspective and accommodation is concerned, the same impression it would obtain from the natural landscape when brought to the place of the entrance pupil of the camera lens. And if color is neglected the impression caused by the photograph will exactly correspond with that exercised by the natural objects.

"This necessarily affects our apprehension of relief, and our estimation of distance must correspond with the conclusions we should derive from monocular inspection of the objects themselves."

Lathe Attachments

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Part I. General Introduction and Description of Division Plate and Pointer.
Part II. Overhead for Lathe and Alternate Form of Same.
Part III. Milling Attachment for Rotary Cutters.
Part IV. Milling and Drilling Spindle.
Part V. Gear Wheels and Rotary Cutters.
Part VI. Suggestions on Changing Plain Lathe to Self-Acting and Screw-Cutting Lathe.

PART II.—OVER HEAD GEAR.

The apparatus about to be described, which is termed overheads, is designed to impart motion to rapidly revolving cutters, milling wheels and the like, and when a

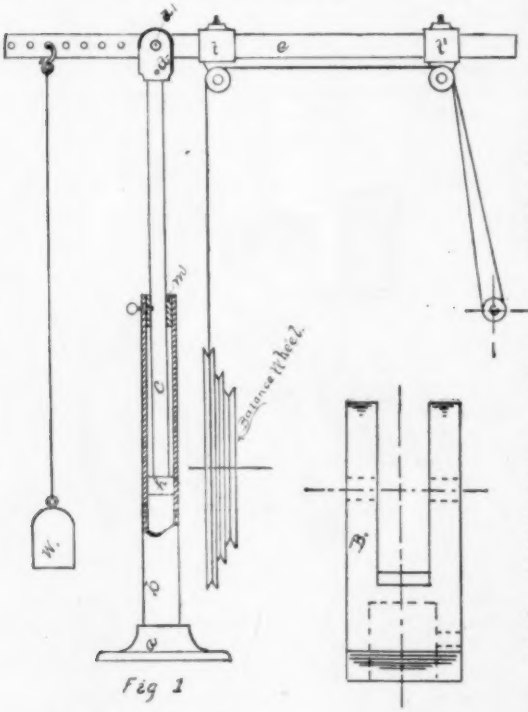


Fig 1

lathe is fitted with such appliances its capacity is vastly increased. In its most primitive stage the overhead consist merely of a roller from 18 to 24 inches long and 4 to 6 inches diameter, usually running in bearings above the lathe, driven from a belt running to the fly wheel of the lathe and by another belt driving the cutting machinery before mentioned. I have at times, when in a hurry, rigged up a pulley on the wall or on a bench back of my lathe and thus made an impromptu back shaft that answered a very good purpose.

The overhead I am about to describe in this article is very simple and easy to make, requiring but three patterns, some old pipe and iron rod, but will do a large amount of work nevertheless.

Fig. 1 is a semi-sectional view of the entire apparatus, showing the balance wheel of lathe and endless belt running therefrom over the movable pullies f and f 1 and rotating the pulley G, which is the controlling pulley of a milling cutter or other machine supported on the slide rest of lathe.

In Fig. 2, A and B is the side and end view, enlarged, of top fork for holding the swinging bar E. Fig. 1 and Fig. 3 "a" and "a1" is the side and end view of movable pullies "f" and "f1" which slide on the bar "E," Fig. 1.

To make the overhead procure a piece of gas pipe b Fig. 1, about 1¼ in. inside diameter and 3 ft. 6 in. long and screw it into the foot or step a Fig. 1. Your plumber will cut the pipe and screw it for a small sum. Next, get a piece of iron rod or mild steel ¾ in. in diameter and about 4 ft. long.

Fit a collar "h" Fig. 1 that will just slide easily but not loosely in the gas pipe and bush the upper end of gas pipe as at "m". The rod can be raised and lowered in the pipe and held at the proper position by the set screw shown at "o". At the upper end of rod fit the forked bearing for the bar "e" to swing in, supported by the pin "d-1". The forked bearing and pullies are both best cast out of brass, though iron will do, the former metal being easier to work. The bar "e" Fig. 1 is of iron 1¼ by ⅜ inches and 4 feet in length and is hung as shown by the pin "d-1", holes being bored at intervals of 1½ inches from the end through which a hook is inserted, a string from the hook holding a weight, "w", which serves to keep the belt tight at all times regardless of the distance the driven pulley "G" is moved by the slide rest.

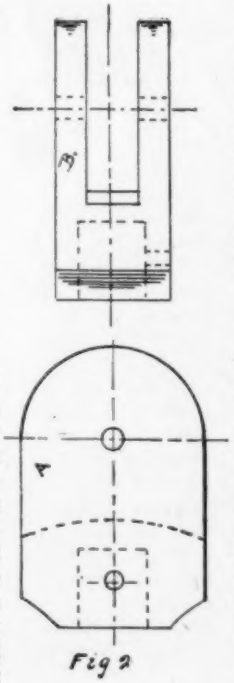


Fig 2

The pullies "f" and "f-1" are easily made, but as some reader may not be familiar with the necessary operations, especially the making of the patterns, I will explain this part briefly.

I have shown an end and side elevation of the hanger at Fig. 4 and also marked the core prints. White pine is the best wood for pattern making, but poplar, or almost any close grained wood will do for the work in hand. Cut the wood to shape shown leaving the core prints where indicated. Core prints are made on patterns and the cores are made of corresponding length

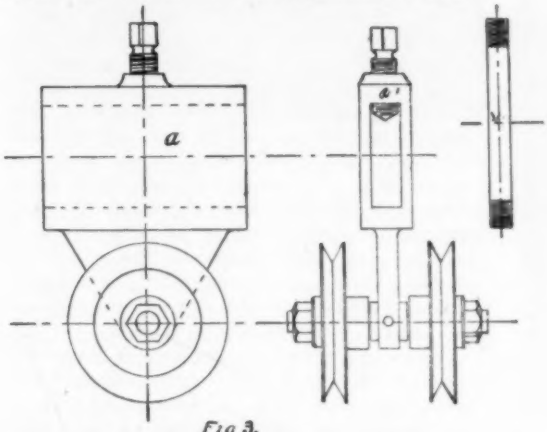


Fig 3.

over all so the metal, when poured in the moulds, will not break down the cores and form a defective casting.

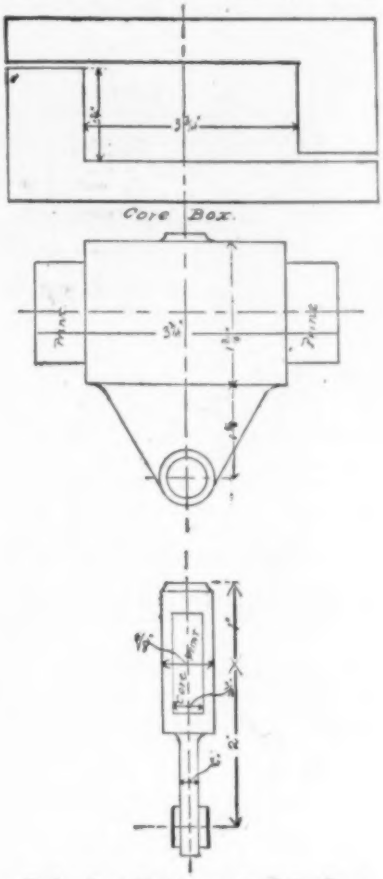
OVER-HEAD GEAR.

The core box is made of two pieces of pine ⅜-inch thick and so cut away that a rectangular hole or box is made when the two pieces are placed together as shown, 1¼ by 1¾ by ⅜ inches deep. The patterns should be sandpapered very smooth and varnished with shellac varnish, the core prints being painted a different color so the moulder will know that the casting is to be cored out and not made a solid casting.

The pulley wheel patterns are made as shown in Fig. 3 except that the grooves in the periphery are not cut, the edge being left solid and the V's cut out from casting after the hole for spindle is bored and while casting is mounted on a mandrel between lathe centers. "b" Fig. 3 shows the shaft or spindle on which pulleys run. It is made from ¼ inch and is secured by drilling a hole right through boss of hanger and shaft and driving in a pin.

The overhead I have shown will do almost any work that can be attempted on a small lathe. It is designed to be secured to the floor by screws through the base, but by changing it slightly it can be secured to the lathe itself. I have used a 3-16 in. round leather belt successfully.

Another form of overhead much in use is made with two uprights and a cross piece at top, all made of gas pipe. A horizontal shaft, supported in bearings at the ends which are in turn supported about 8 inches from top of uprights, carries a pulley at the left end in a position over the fly wheel of lathe and is driven by a belt



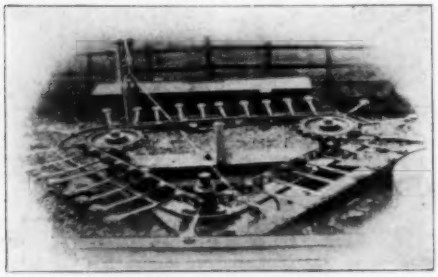
Detail of Patterns & Core Box.

from fly wheel. On the right of fixed pulley a cylinder of wood about 18 inches long is secured. A belt runs over this and a pair of weighted tightening pulleys and down to the pulley of milling cutter or other machine to be driven. The two uprights can be secured from the floor or be secured in sockets fastened on frame of lathe and should be of such height as to allow of reaching the moving parts easily

while standing on the floor. In the next article will be given a description and drawings of a simple device for carrying the rotating cutters used in cutting small gears, fluting taps and similar work.

MACHINE TO PLACE TORPEDOES ON RAILWAY TRACK.

The frequency and density of fogs in England have led to the general use of torpedoes for signaling purposes. So many are used a machine has been built to place them



Automatic Torpedo Placer

upon the track. The construction of the device will be understood from the illustration. It is operated by means of wires worked by levers in the nearest signal tower. One filling of the machine furnishes thirty-six torpedoes, and an electric indicator in the tower shows when the torpedo explodes and how many remain unused.

RAILROADS USING BLOCK SYSTEMS.

The numerous fatal railway accidents of the past winter have attracted general attention to plans for safeguarding the operation of passenger trains. The daily press has insisted on the use of the block system being made compulsory by national legislation.

It would appear that a very fair start has already been made in the use of the block system. Eighty-three roads have it in whole or part, covering 39,281 miles.

HOW TO BUILD A SMOKE HOUSE.

Where the householder has room in the back yard available for the purpose one of the luxuries of living is to have a smoke house and cure your own meats. The expense of building one is small and it will last for years. The main point to guard against is hot smoke, which dries the meat and hardens it. The Rural New Yorker recommends a house of brick or stone, though wood will answer. It should be 6 by 8 feet on the floor and about 7 feet high.

The house is best set on posts two or three feet high, by which it is safe from burrowing vermin. The smoke is made in an adjoining fireplace, built in the form of an oven, arched over on the top and needing no building to protect it, or the fire may be made in a stove under a shed or in any convenient way by which green hard wood, corncobs or other clean vegetable fuel may be burned slowly so as to make a dense clean smoke. The smoke is carried into the house as low as possible by a common stovepipe fitted in the top of the fireplace or stove, and this pipe should be long enough to cool the smoke and condense the more acrid of the acid vapors which would spoil the fine flavor of well-smoked meat. The smoke should be cooled so that there will be no drip of this acid in the house. Ten feet of pipe exposed to the open air under cover of a shed or open roof or inverted V cover will ensure the proper heat of the smoke. Green wood of any kind except pine may be used to make the smoke, and the fire should be kept low to make smoke rather than heat. The hardwood chips gathered in the woodyard, corncobs, any waste clean fuel in fact may be burned, and the smoking is best done on a still damp day, when a dull fire may be easily kept. A windy day, like other kinds of blustering, does very poor work. A low steady smouldering fire does the best work. Smoke one hour a day for 10 days. This will give—with good work in the way indicated—a very fine-flavored bacon or smoked beef or sausage.

Lots of good features are being added to Popular Mechanics. The electrical experiments, ever popular, continue with increasing interest. The department of "Mechanics for Young America," is proving remarkably pleasing to the boys. Next month we will tell them how to build boats. "Great Buildings of America" contains a picture and description of a different building each month. "Lathe Attachments" contains information that is invaluable to the users of small lathes, and much of interest to those who use large ones. And the ten pages of "Shop Notes" which have caused Popular Mechanics to be regarded almost as a necessity among craftsmen, are getting better, more enlightening all the time. You are sure to get a dollar's worth of information out of Popular Mechanics before the year is out.

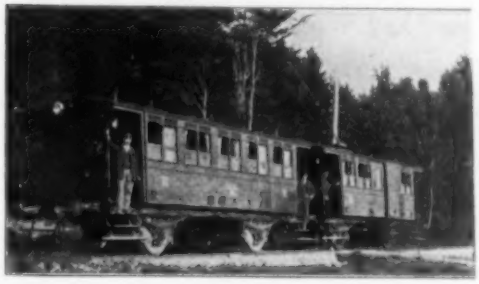
Electric Feeders to German Railways

Regular Coaches Switched off and Hauled by Trolley Cars Without Changing Passengers

In Germany and other countries of Europe short branch lines of railroads are now being operated almost exclusively by electricity. The change from steam has resulted in savings of millions of dollars to the railroads, and the change has been as agreeable to the public as it has been remunerative to the companies. As a further economy, waterpower is employed wherever possible to generate the electricity.

Dam of Power Generating Plant

The illustration shows a motor car and trailer and a power generating plant employed by the Ulm and Friedrichshafen railroad of Germany. At Meckenbeuren on this road a short line branches off and runs to Tettnang, a distance of not quite three miles. This short line is now operated by electricity, and is an example of the many that have been similarly transformed from steam of recent years. The regular passenger and freight cars of the main line are hitched to the electric car and hauled to Tettnang as trailers. The water plant, near Meckenbeuren on the main line, furnishes power for the branch railway and also for lighting the stations and for supplying power and light to Tettnang.



Motor Car and Trailer

The Electric "Canal Mule" Has Come

Hauls Trains of Boats and Marks a New Era in Inter-State Water Haulage

Improvements in steam and electric roads instead of putting an end to canal traffic, as many predicted, now seems destined to increase the importance of such traffic and to restore state canals to their prominence as factors in state and interstate commerce. The old-time canal mule has been superseded by the electric "canal mule." It may not be long until electrically hauled trains of boats will be moving along our canals, carrying greater tonnage than the electric cars that traverse the interurban lines. The canal trains, consisting of ten or more boats, will be hauled by an electric towing locomotive which runs along the bank of the canal. Such a method of haulage has already been placed in operation on the Cincinnati-Dayton section of the Miami and Erie canal, between Cincinnati and Middletown, a distance of 42 miles. It will be employed on the entire section, 68 miles long, as soon as it is completed. An average speed of three miles an hour is attained for a string of ten canal boats, each 80 feet long, and the distances between them is such as to make the entire train about 1,500 feet long.

Power for the electric towing locomotive is supplied by a number of generating stations along the canal. The application of electricity to the towing of these boats undoubtedly paves the way for the electrification of the enlarged Erie canal in New York as well as of other canals.

Even old Egypt is being invaded by the automobile, the number of which must appear on both front and rear of each machine. Speed is limited to 10 miles an hour.

Professor and Madame Curie were awarded the grand prize of $20,000 for their discoveries in connection with radium.

The Greatest Electric Shock on Record

Receive Twenty-Four Thousand Volts and Live

Electric shock is one of the things which laugh the books to scorn. According to established theory a current of 24,000 volts should be several times fatal, and yet there are two men alive today who received this terrific shock; while recently in Pittsburg, a wet flag whose folds chanced to connect two wires, one alive with 2,000 volts, was the means of killing three people.

The accident in question grew out of some emergency repairs in the power house of the electric company at Las Paulo, Brazil. The outgoing wires carry a voltage of 24,000. The switchboard has a double set of bus-bars and while repairs were being made in the upper half, the lower bus-bar carried the entire load. The dangerous task of working among the mass of rods and wires surcharged with death was undertaken by an Italian expert, Archimedi Lazzari, and Tommie Bevan, Jr., son of the general superintendent. The escape of these two persons was so remarkable that we give the following details as related by a special correspondent of the Electrical Review, of London:

Every precaution had been taken against accidents, and, in, fact, it was over-zeal to be cautious which caused the mishap. The buses being divided, and the work being carried on upon the dead section, one of the operators, Thomas W. Bevan, Jr., son of the power house superintendent, went over to work near the live half. Archimedi, wishing to warn him of his danger, took hold of Bevan, Jr's. wrist, and leaned forward to speak with him; at the same time he had his foot against an anchor bolt of the iron framework which had just been taken down. This bolt was cemented on the floor of the gallery (the high-tension board being on a gallery), the latter being made of steel rails with brickwork arching between the rails. Archimedi leaned over too far and came too near one of the 24,000-volt bare copper wires, which was one of the secondary leads off the main transformers to the high-tension board. Immediately the current jumped on to his shoulder, passing through his body and out at his feet on to the anchor bolt. Both Archimedi and Bevan, Jr., remained transfixed, while Mr. Bevan, Sr., thinking it was his son who was on the wire, leaped into the air (in order to disconnect himself from the ground) and plunged against his son. The shock pulled both men off the wire, and Archimedi loosened Bevan's wrist, only to fall near the wire again, in almost identically the same position as before, only this time the whole current was passing through his own body, not as before, when a portion must have been shunted through Bevan, Jr. Mr. Bevan, Sr., who was thrown violently to the floor, tried to kick Archimedi's foot from under him, only to find that every time he (Mr. Bevan, Sr.) touched the stricken man's foot, his own legs were shot back with terrific force. Archimedi remained thus until the power was taken off. He must have been fully half a minute under the action of the current. He claims to have been conscious all the time, and says that he felt nothing. In fact, he was able to describe exactly what occurred, and says he felt the power taken off the first time, and then come on again, as he fell the second time near the wire. On the power being taken off he immediately became unconscious, and his mouth had to be opened with the end of a file, and a piece of wood put between his teeth to keep them apart, while his arms and legs were being worked so as to produce artificial respiration. In a little over 10 minutes Archimedi was able to walk about on a man's arm. He felt sick and had fearful burns on his shoulder and his foot, but after about six weeks' absence he came back to work and has not missed a day since. Both the Bevans suffered nothing greater than little burns over the body, wherever the current came in contact.

Just imagine the sending your lady friend a box by wire! It seems absurd, doesn't it? yet that is what they propose to do next. The "Electric Post" is the name of the device by which it is planned to send all kinds of packages and letters by electric wires. Popular Mechanics has arranged for an article on this interesting subject which will appear in the near future. Nearly everything new is written about in Popular Mechanics.

Americans Use Too Much Water

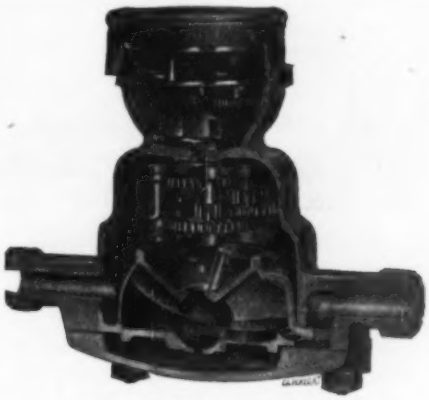
Meter System of Making Them Pay for What They Consume Being Adopted

Americans are getting so they use so much water that the plan of introducing water meters and making the consumer pay for the water in proportion to the amount he consumes is being adopted in many of the leading cities. Statistics gathered by G. I. Bailey, of the American Society of Civil Engineers, show that Americans now consume more water than any other people in the world. Starting with an average of ten gallons a day for each person under the old system of charging, it has increased, under the flat rate system, to an average of 137 gallons a day for each person in the United States. Of course, it does not require 137 gallons a day to satisfy a person in the far arid west, where the water is often carried miles.

Tests with meter measurements, making the person pay for the amount of water he uses, shows that Americans waste water; that they use twice as much as they need.

A leading manufacturer of New York city has patented a water meter that is now being used in many municipalities to measure the water used by consumers. In this meter a light disk formed of hard rubber is placed in a compartment, which may be approximately described as a hemisphere with a spherical segment taken out of the top. A slit cut in the disk upon one side fits over a vertical radial septum in the disk chamber. This is clearly shown in the accompanying cross-sectional view of the meter. The disk itself as actually constructed is conical in shape on both the inner and outer surfaces. From the center of the disk a vertical spindle projects through a circular opening in the disk chamber and its upper end rests against a circular block. It is thus constrained to move in a circle.

Now, it will be seen by examining the cut and considering the possible motion of the disk that there is never a free opening between the water inlet passage and the outlet, but that the disk is always interposed. However, since the water pressure is admitted to one side, if the pressure of the exhaust is any less the disk will be caused to tip, resulting in an increase in the volume of the portion of the disk casing opening to the supply and a decrease in that opening to the delivery. The continuation of this motion causes the vertical spindle to travel in a circular path, while the disk itself may be said to "wobble." The motion of the vertical spindle is reduced by an intermediate train of four gears, which operates a slow moving spindle extending through a stuffing box in the top of the meter casing. This spindle operates the gears moving the counter.



New Water Meter.

This counter may be either of the pointer-and-dial type or the straight reading type, and may be arranged to indicate in cubic feet, gallons, liters, etc., as required.

JERUSALEM HAS ITS FIRST ICE FACTORY.

An ice factory has been established in Jerusalem by an American and a German and ice is being used in that antiquated city for the first time in its voluminous history. It is a small factory, the power being furnished by an oil engine of three horse-power. The compressor is of French manufacture. The product of the factory is sold at about 2 cents a pound. The sale amounts to about 700 pounds a day. The capacity of the works is 1,400 pounds daily. The water used in rain water, from cisterns, and the ice is like crystal. When the ice was first put on the market a short time ago, the people, none of whom had ever seen ice in Jerusalem before, did not know what to make of it and the demand was small. Soon, however, the hospitals and hotels began to use it and now nearly all the foreign residents and many wealthy native families are the consumers.

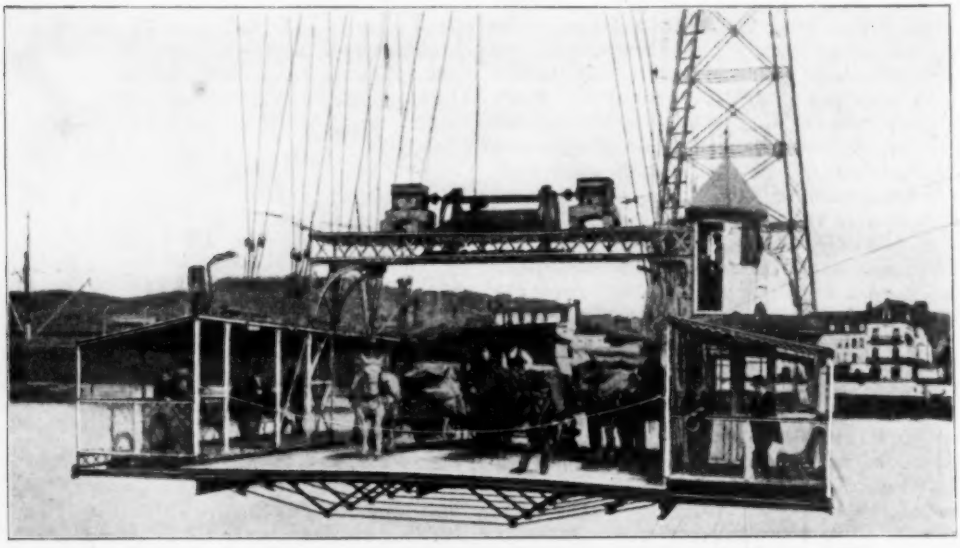
Overhead Ferry at Nantes, France

On the banks of the river Loire, at Nantes, France, rise two stately steel towers, 200 feet in height. Between the tops of these towers, at a height of 165 feet above the water, streches a suspension bridge. This bridge, however, is not used for travel of passengers, but supports steel rails on which run immense wheels, or trolleys, contained

Passengers Being Swung Across a Stream.

in a sort of inverted car. From these wheels, by means of strong steel cables is suspended the ferry in which are transported passengers and vehicles. The ferry is some feet above the water, and its movements are under the perfect control of the operator who occupies a small cab above the passenger compartment. Electricity is the motive power, and the motors are placed on the upper deck of the ferry. The ferry cost $200,000, and this unusual type of construction was chosen to avoid the long ascent and descent for the usual form of suspension bridge, which in this case was necessarily very high in order to permit ocean shipping to pass below. Passengers pay one cent fare, and wagons from five to ten cents each. The distance between towers is 490 feet.

There are similar ferries at Rouen and Martion, France; and Bizerte, Tunis.



Swinging Ferry Carrying Passengers and Freight.

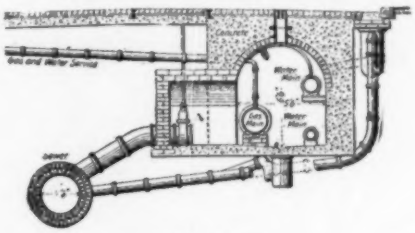
SMALL BOY VERSUS THE HORSE.

By adding a third wheel, a light steel frame and a box to the bicycle, the small boy may be employed to take the place of the horse in the delivery of light parcels. With this combination delivery cart and bicycle he makes much better time than with a basket or push cart. The invention is designed for attachment to any bicycle, without adding materially to the power necessary to propel the vehicle. The light steel frame and the third wheel support one side of the carrier while the other side rests on the frame near where the frame is clamped to the bicycle. There is, of course, sufficient space between the bicycle and the box of the carrier to permit free motion of the foot.

TUNNELS FOR PIPES IN STREETS.

Nobody will ever know how many million dollars could have been saved in the city of Chicago alone had there been constructed, say 20 years ago, pipe tunnels under the streets in the business district. American cities will come to these things some day, indeed a beginning is being made already, but we are away behind English and European cities in this respect.

The city of St. Helens, in the North of England, has an extensive system of these tunnels, or pipe galleries as they are called over there. These tunnels are built and

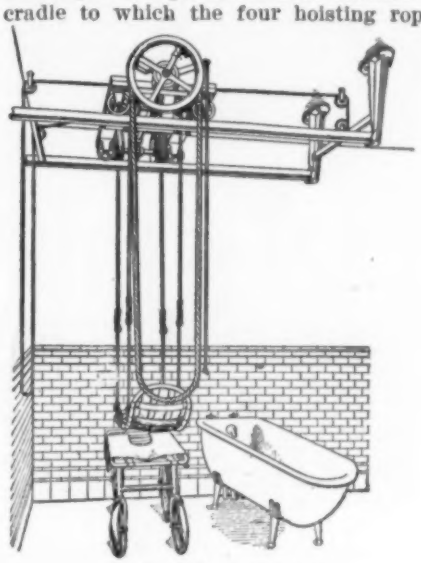


Pipe Gallery.

owned by the city, and instead of placing the gas, water pipes and various electric wires in conduits, they are all carried in the pipe galleries. The rental to the various companies for the use of the tunnels yields the city a good income, while the companies save thousands of dollars, as it is so much cheaper to run wires in the tunnels than to dig up streets and replace the pavement. Incidentally also the public is put to no inconvenience when some company wants to run wires or pipes. The pipe gallery illustrated is 6 ft. 6 in. high and 5 ft. 6 in. wide and built of concrete. At intervals are ventilating openings at the top, while large side tunnels afford ample room for receiving and handling the pipes as new lines or extensions of old ones are made. Special provision is made for drainage, even to the extent of taking care of large bursted mains, should such an accident occur. Electric lights are placed every 28 feet. The intersecting streets are all indicated by name, on plates fixed to the wall. These are only a few of the details, but will serve to show how practical and sensible such a public work can be. The large continental cities have, of course, been so supplied for many years, and it seems strange that in this country, that brags so much on its superiority, we should still go on tearing up costly pavements, digging ditches in the public streets, making a muss, obstructing travel, all to get a small pipe or a handful of wires underground. In these days of cement and underground tunnel construction, which can be carried on without anyone above ground even knowing the fact, there is no longer any excuse for American cities tearing up streets as in the past. The tunnels would more than earn their interest from the start.

BATH HOIST FOR INVALID.

The very latest thing in a bathroom is a hoist for lifting an invalid out of a chair or rolling table, swinging him over the bathtub, and then gently letting him down into the water. The device can be operated so easily that a twelve-year-old child could handle a person weighing 200 lbs., surely and safely. The patient sits or reclines in a cradle to which the four hoisting ropes



An Invalid's Bath Hoist.

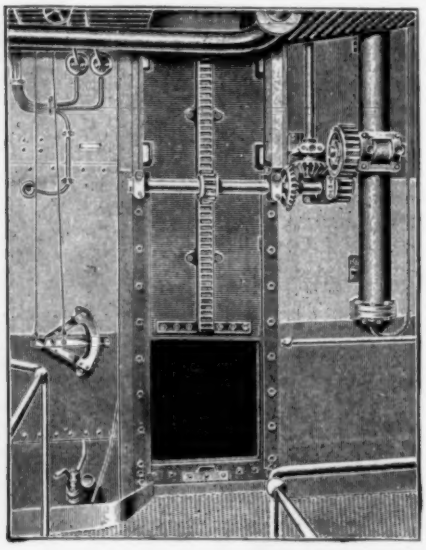
are hooked. The elevating machinery is on the same plan as the hand hoists used in machine shops. When the cradle has been sufficiently raised it is swung over the tub, and slowly descends of its own accord, a brake regulating the speed. To leave the tub the process is reversed.

SILK WORMS MADE TO DYE CLOTH.

Experiments in Roubaix, France, according to claims, have succeeded in making silk worms do their own dyeing. By feeding the voracious caterpillars on leaves containing a natural or artificial pigment, they are said to have obtained raw silk in red, blue and bright orange. Thus before long we may see "natural colored silk" made and sold, no doubt at a fancy price.

BULKHEAD DOORS IN UNSINKABLE SHIPS.

The modern steel ship is becoming more nearly unsinkable each year. The arrangement of the hull in water tight compartments separated by steel bulkheads has long since been generally adopted. With the practical application of electricity it became possible to open and close every bulkhead door in the ship by simply touching the proper buttons of the switchboard on the bridge or in the pilot house. All our latest battle ships are so constructed. There has been the terrible danger, however, that incident to the excitement which must necessarily prevail in case of fire or collision which would open the ship's side, that in the haste to close the bulkhead doors some unfortunate officer or seaman might be shut into one of the compartments to suffer death by suffocation or drowning as the case might be.



Hydraulic Bulkhead Door Half Open.

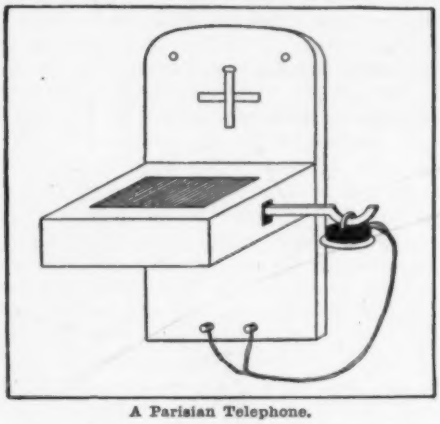
The Deutchland is admittedly one of the most perfect ships ever built, and the vessel has now been equipped with a system of operating the bulkhead doors. An hydraulic system using 700 pounds pressure operates the entire system at once by means of two valves; but any door can be worked independent of all the others. The system goes farther, however, and should any seaman be caught in a compartment closed from the bridge, he can still operate the door and escape and close it again. The illustration from the Shipping World, London, shows the working gears which operate the doors, also the hand lever at the left of the door for working the door on the spot. When a door is closing from the bridge control an electric gong sounds automatically for twenty seconds in the compartment to be flooded, which ordinarily would give time for the occupants to escape.

If the ship should spring a leak unknown to anyone, when the water reaches a certain height an automatic alarm sounds a gong and closes the door by means of a float which in rising opens a valve and sets the gears in motion, thus closing the door.

ANTIQUATED TELEPHONE IN PARIS.

The telephone system of the great city of Paris is twenty years behind the times. Not only are the switchboards of a type which have been discarded years ago by even the smallest exchanges in this country, but the telephones are something absoltuely ludicrous. The American Telephone Journal says:

They consisted of a wooden box which looked something like the sketch. A common vibrating bell is used for a signal and a push button for calling. The shaded



A Parisian Telephone.

place on the top of the lid is the diaphragm of the transmitter, which consists of little carbon sticks touching each other. To hear and see a Frenchman talk through one of these is something worth traveling far to see.

A great cantilever bridge with a clear span 1,800 feet, and railroad track 160 feet above the Strait of Canso, will be built to connect Cape Breton, N. S., with the mainland.

Light at Port Antonio, Jamaica

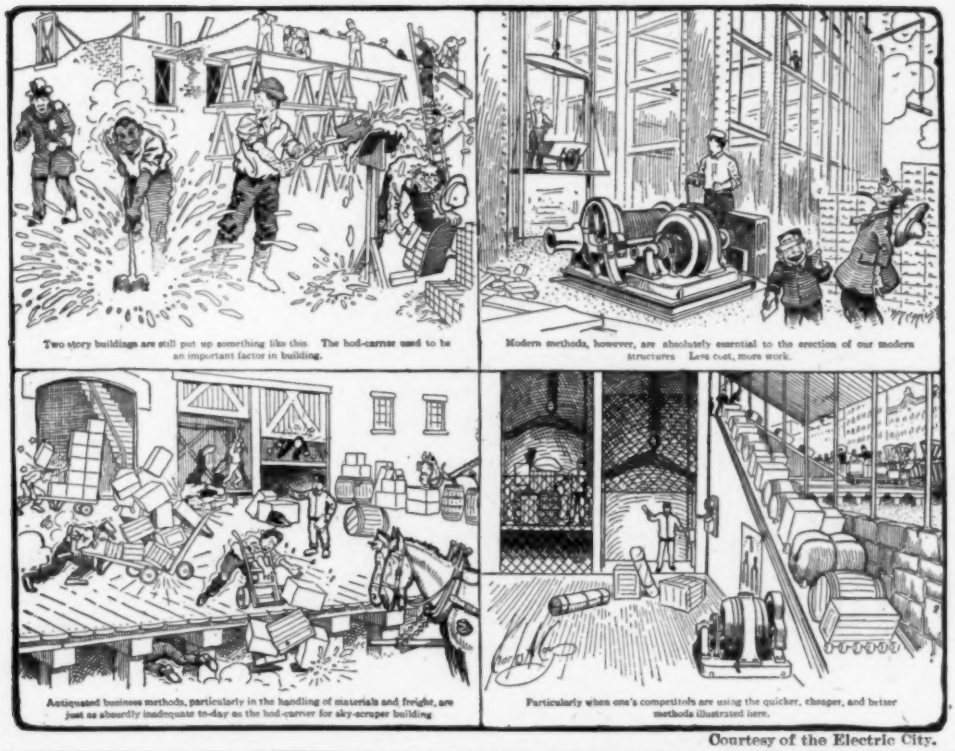
FOLLY POINT LIGHT at the entrance to the harbor of Port Antonio, Jamaica, is the first sight that greets the tourist on nearing that "land of smiles and sunshine". The light has long stood at the harbor entrance, but of late has been equipped with modern machinery and lenses and is one of the finest lights on the Caribbean. With its horizontal stripes, alternately black and white, the towering lighthouse serves as a guide by day almost as well as does the light by night. The Folly Point Light stands in the center of a scene noted for its picturesque appearance. Crystal streams on every side rush into the sea while the spray from the lashing waves leap as high as the light. The United Fruit Company's steamers that ply between the United States and Jamaica make regular landings at Port Antonio.

TO DISTINGUISH PORTLAND FROM SLAG CEMENT.

At the Fifth National Congress of Applied Chemistry the statement was made that it was not possible by chemical means to determine the proportions of a mixture of blast furnace slag and Portland cement. H. Seger and E. Cramer, of Berlin, Germany, have investigated this statement, and find a distinct difference in the capacity of these two bodies for the absorption of water, as well as a great difference in the solubility of each in water. For instance, the mean value of a number of water absorption tests gave 11.46 per cent for Portland cement, and 0.78 per cent for slag. The solubility of the two showed fully as great a difference.

Send for Popular Mechanics premium list.

The Old Way and the New


Two story buildings are still put up something like this. The hod-carrier used to be an important factor in building.
Modern methods, however, are absolutely essential to the erection of our modern structures. Less cost, more work.
Antiquated business methods, particularly in the handling of materials and freight, are just as absurdly inadequate to-day as the hod-carrier for sky-scraper building.
Particularly when one's competitors are using the quicker, cheaper, and better methods illustrated here.

Courtesy of the Electric City.

PANCAKE LEATHER.

Pancake leather is composed of thin sheets of leather pasted together and dried under tremendous pressure. The result is a strong, heavy piece of leather which to all appearances was tanned from a single hide. It is used in making parts of shoes, for the backs of brushings and a great variety of purposes. Hide and Leather tells how pancake leather is made:

"The trimmings, splits, etc., are dampened and in the moist state smoothed out and carefully laid in a form of say 12 by 16 or 11 by 26 inches, and each piece of trimming when laid into the frame is rubbed over with paste, and in this way a compact cake of a certain substance is built up, composed of nothing but layers of leather and an excellent paste which is said to have waterproof qualities. The sheet is then put under a tremendous pressure, dried and rolled, and is then absolutely solid and compact."

Pancake leather is much cheaper than the solid leather for which it is used as a substitute, often to the disappointment of purchasers of the manufactured goods.

ANTI-VIBRATING BICYCLE HANDLE BUFFERS.

The "India Rubber Journal," of London, says: "An anti-vibratory device for the handlebars of cycles has long been wanted and of late a great number of patents have been taken out. Rubber has been used more or less in many of these patents, but not with any great success hitherto. A new arrangement, however, strikes us as being a very good idea, and more practical than any other we have yet seen. The handlebar is pivoted in a sort of guiding-cage on the top of the stem. The rubber buffer is introduced above and below the handlebars so that all upward and downward movements of the stem are communicated to the handlebar only after it has been partially absorbed by the elasticity of the rubber. Theoretically, this arrangement is not perfect; practically, however, it does its work efficiently, and reduces greatly the vibration.

Popular Mechanics "is written so you can understand it."